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the magazine of energy systems engineering

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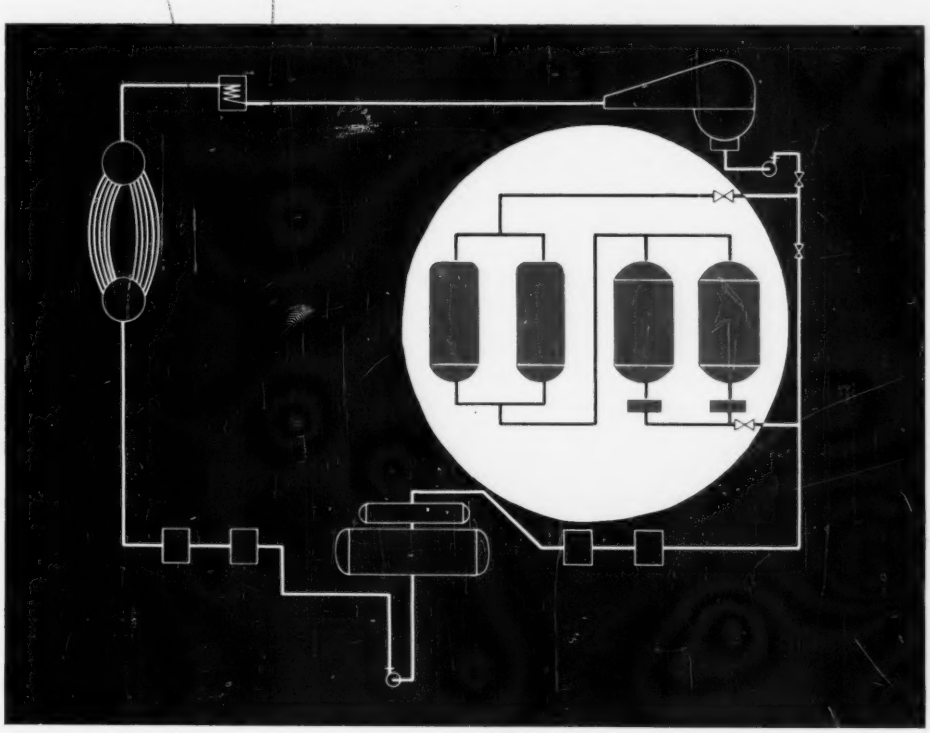

Condensate scavenging: what's ahead?

a TD report • 51

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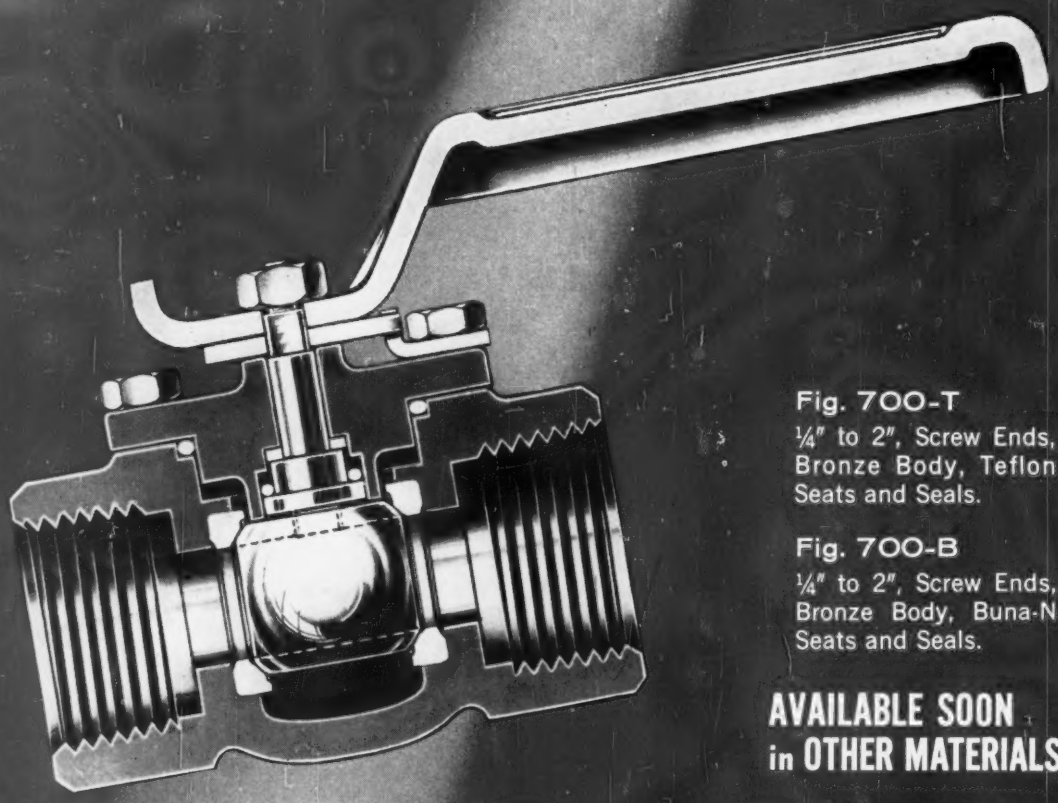

Fig. 700-T
¼″ to 2″, Screw Ends, Bronze Body, Teflon Seats and Seals.

Fig. 700-B
¼″ to 2″, Screw Ends, Bronze Body, Buna-N Seats and Seals.

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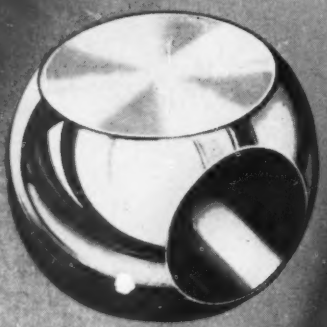

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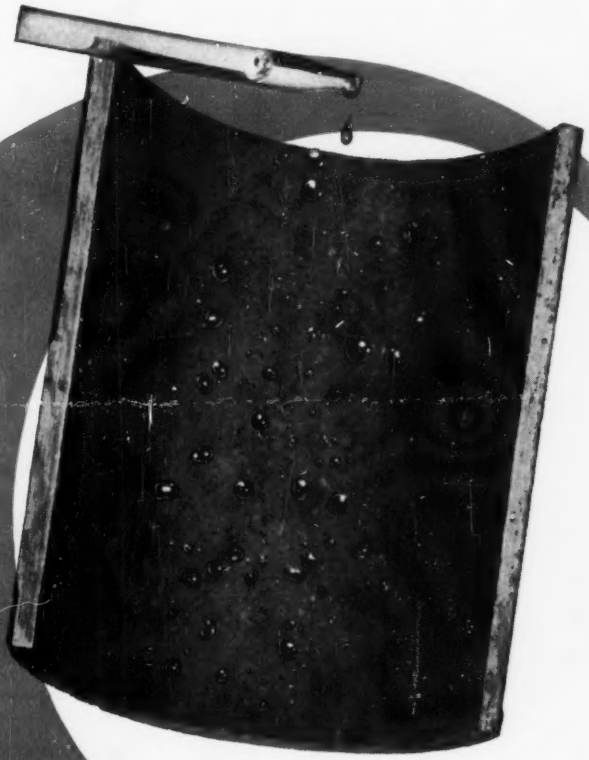

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speaking of **Power**

Air pollution, subject of our 48-page special report in the December issue, triggered a wave of letters and phone calls. The following letter from Arthur J Benline, Commissioner of Air Pollution Control for the City of New York, brings up a particularly important point.

"I have read with great interest the special report on air pollution. It is a report of great significance.

"But, a question which I cannot help raising is: now that we have this comprehensive, accurate and interesting report, what will be done about it? How will we see to it that those who should read it and do something about it, do so? How shall we get it to the public at large—so that they can realize, on the basis of an objective, factual report, that air pollution is a matter of great concern and of enormous complexity and that each person, as you have stated, must do something about it?

"We need the effective cooperation of laymen at all levels and I don't get the feeling that the report contains the elementary psychology that will stir up the public. . . . Year in and out those people who actually read such articles seldom if ever do anything constructive about implementing the suggestions they contain.

"It is extremely important that this special report reach as many people as possible—political figures, civic leaders, students, the ordinary interested citizen. It would be tragic if this splendid document were confined for all time within the December pages of POWER. Its value has been shown on at least two occasions since we received a copy of the report, just yesterday.

"I hope that POWER will see to it that this special report receives the widest possible circulation. It is a report which, I am sure, will be quoted and referred to for a long time to come by the professionals in the industry."

For the story on what we did to bring this report to the attention of those outside POWER's regular audience, turn to *Comment*, pp 80-82.

Lou Rowley

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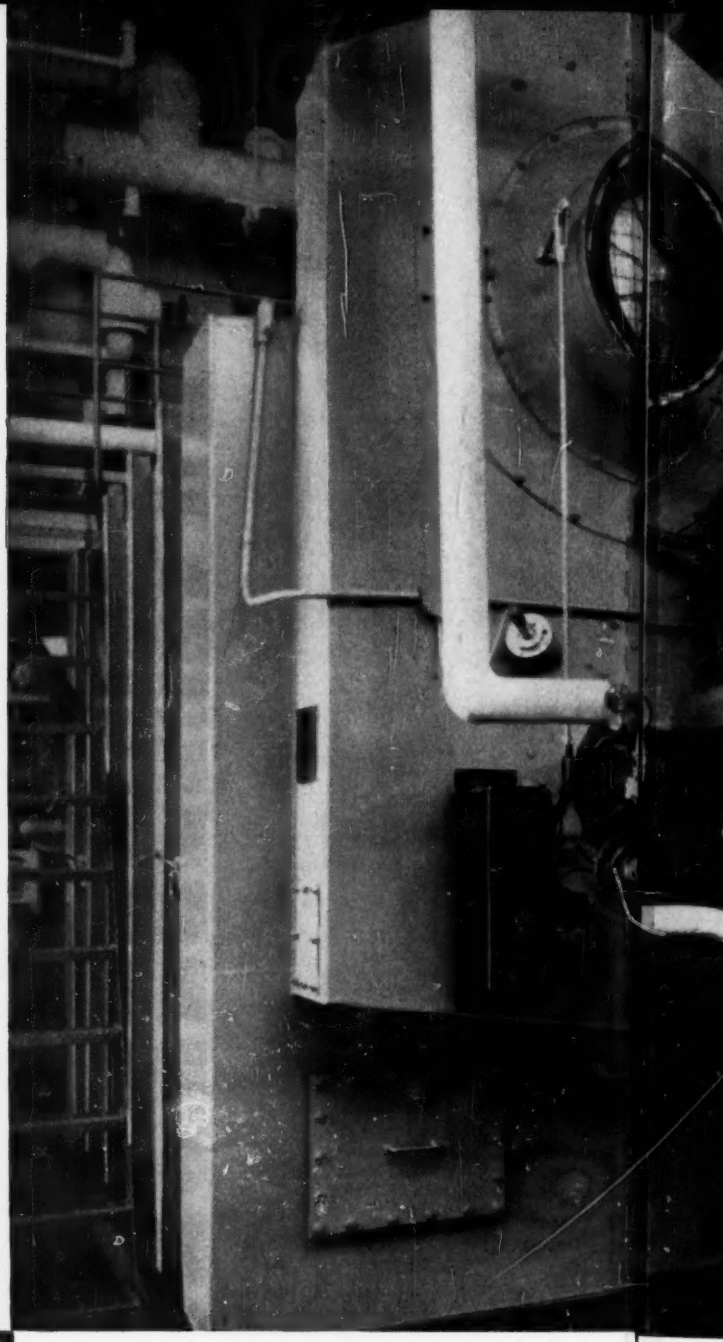

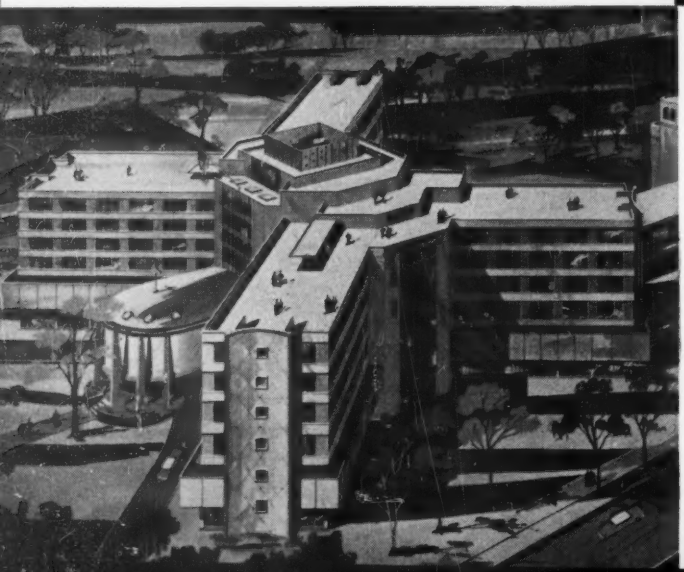

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That's why so many institutions such as Chicago's Hol Cross Hospital have selected B&W Package Boilers to mee their steam requirements. Supplying clean, dry steam fo critical uses such as heating, laundry, kitchens and sterilizers B&W Package Boilers have become a standard of dependa bility in hospitals and other institutions throughout th nation.

Dependability, however, is only part of the story. Budget

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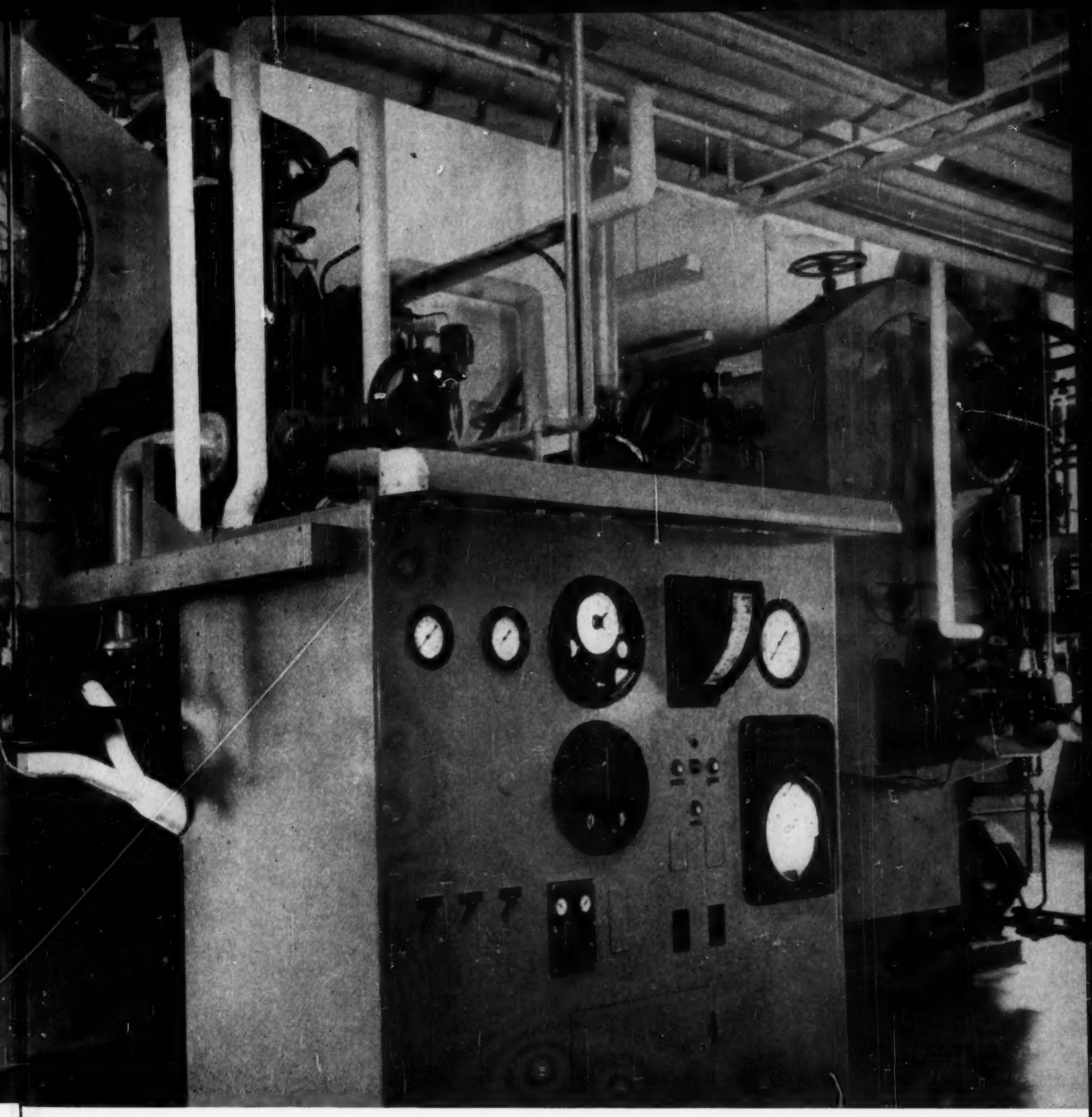

minded hospital management has found the low maintenance, cleanliness of operation, high operating economies, flexibility, rapid response to demand and maximum capacity in minimum space afforded by B&W shop-assembled units equally attractive features. What's more, they appreciate the assurance that at any time during the life of the boiler, even 20 or 30 years hence, B&W's nationwide service organization will be promptly and economically available if needed.

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BOILER DIVISION

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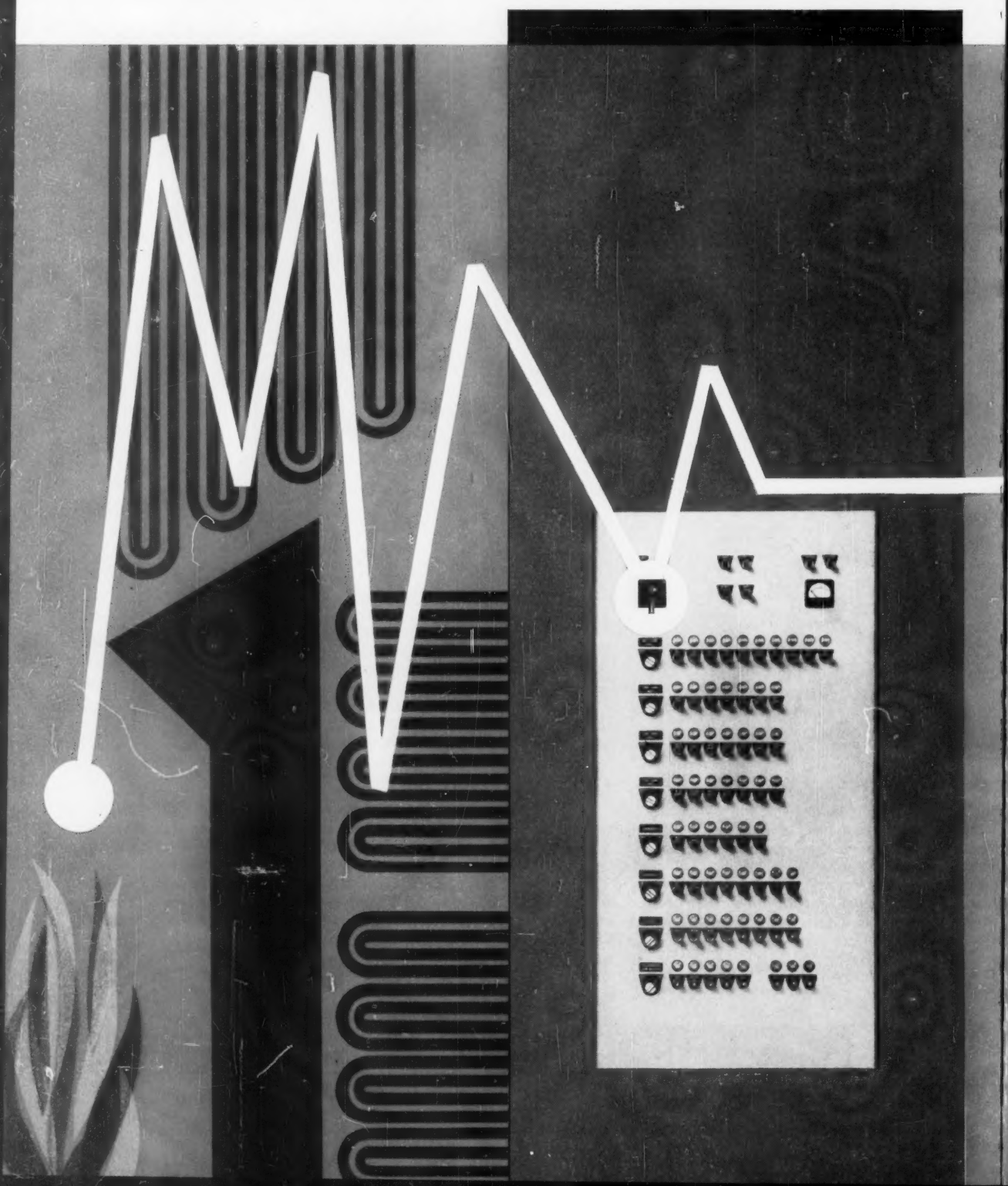

Optimum frequency of blower cycling is assured with Monitormatic . . . Diamond's completely automatic boiler cleaning system.

Monitormatic is an automatic method of maintaining constant furnace cleanliness and heat absorption. It responds automatically to changing boiler conditions and eliminates indiscriminate, unnecessary or insufficient blowing. Savings are realized through optimum use of blowing medium, minimized soot blower maintenance, less compressor maintenance if air is used as blowing medium, and reduced operator time. It also automatically adjusts the cleaning system to fuel changes.

Monitormatic is readily and economically applicable to new or many existing Diamond Selectromatic Systems; is another example of why "Diamond Developed" means more economical power generation.

At your request, our Engineers will be pleased to evaluate the application of Monitormatic to your specific system. Call, write or wire for complete information.

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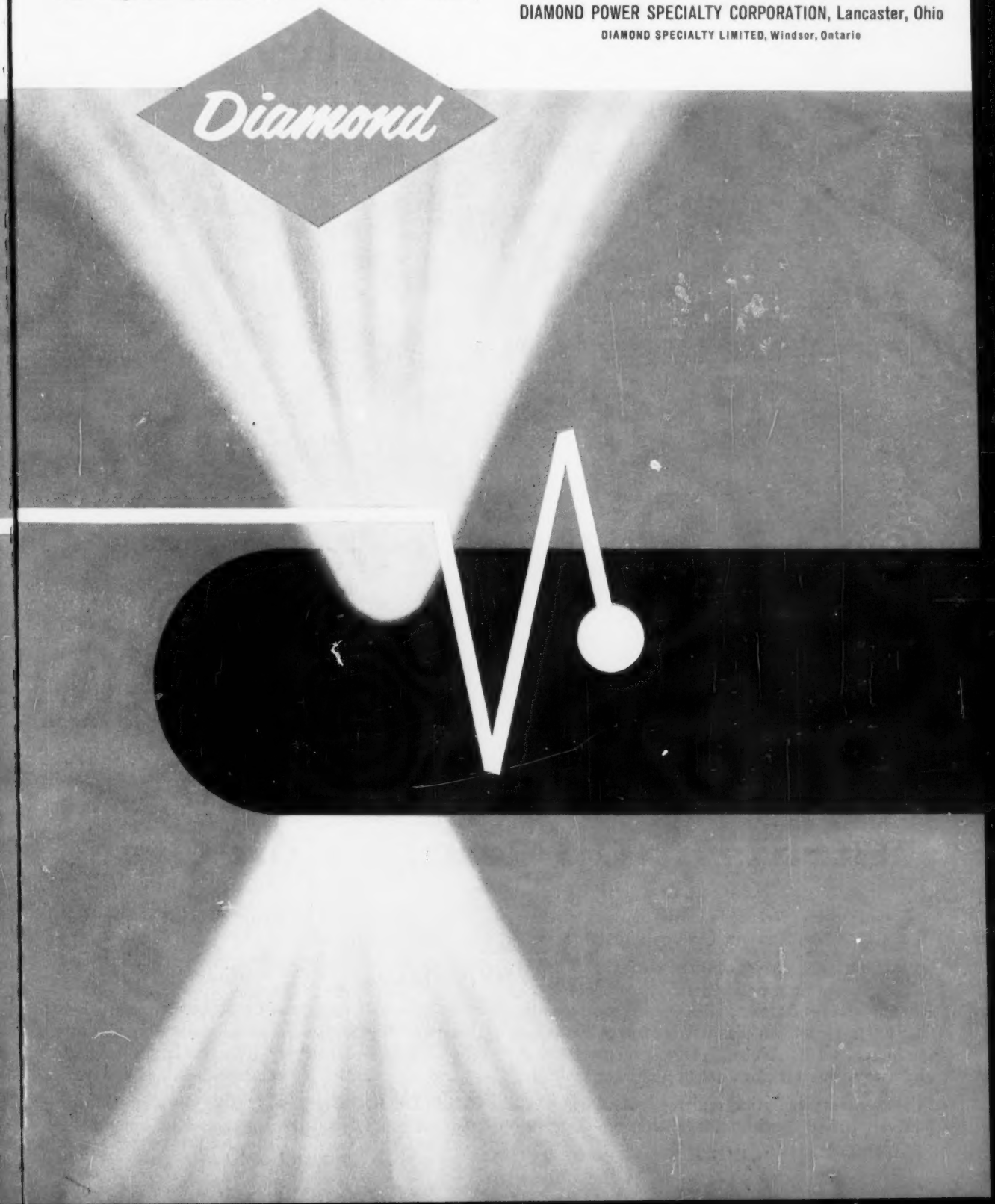

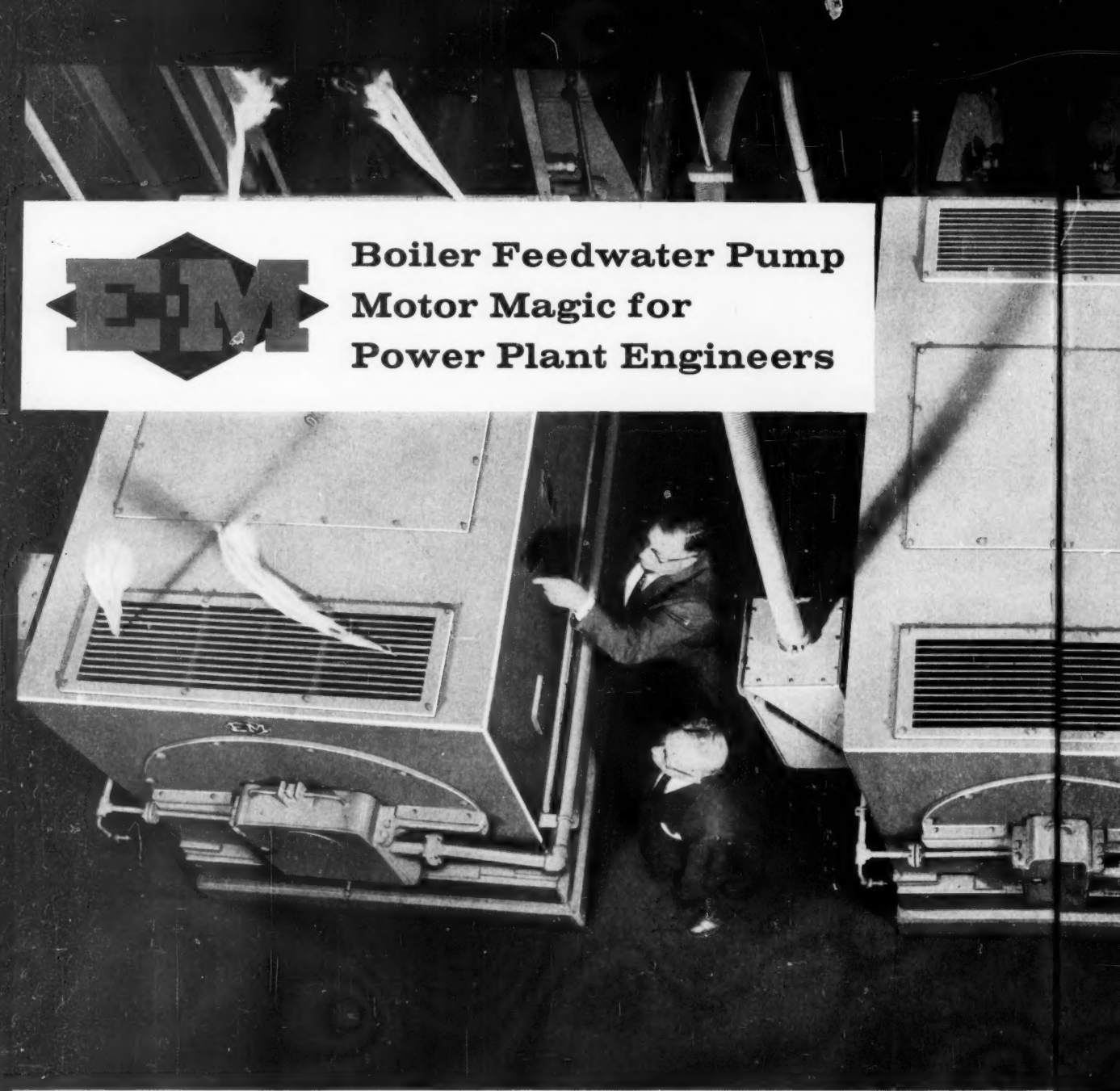

Boiler Feedwater Pump Motor Magic for Power Plant Engineers

Shown above are three E-M Straight-Up-Ventilated Squirrel-Cage Induction Motors driving boiler feedwater pumps at High Bridge Station, Northern States Power Company, St. Paul, Minnesota. Each motor is rated at 2500 hp, 3600 rpm,

Straight-Up Ventilation Gives

The space-saving secret is in the natural air-flow design of E-M's Straight-Up-Ventilated Motors.

With straight-up ventilation, each motor takes in cool, clean air from both sides near floor level, circulates it in and around all operating components. The warm air is then discharged *through the top* of the motor housing. Natural convection carries it up and away where it can't heat up adjacent motors.

Thus cross-circulation and recirculation are effectively halted. Each motor has its own exclusive "convection stack" which permits compact installation with cool operation.

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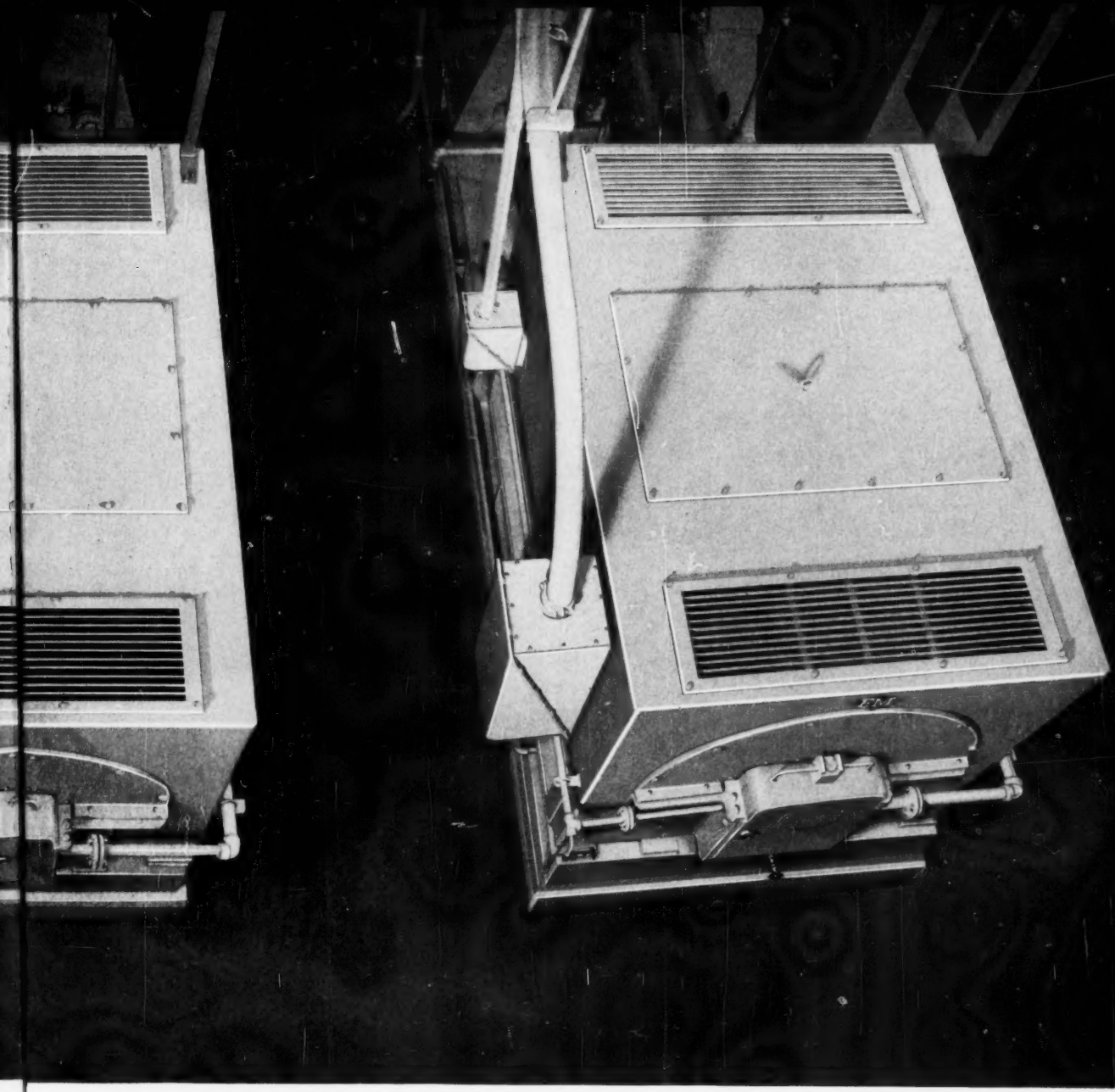

2300 volts. O. W. Johnson, plant superintendent, and C. H. White, assistant plant superintendent, are discussing advantages of straight-up ventilation of machine at left. Air-flow is indicated by paper streamers temporarily attached to discharge louver.

You a Compact Installation!

acoustical control features which help to minimize windage noise. The motor is not dead silent . . . just remarkably hushed.

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Minneapolis 13, Minnesota

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m — monitor (scan and alarm)
p — produce stored information for future use (tape, cards) **c**—compute **r**—control

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10. Orange Co., Tex.	A/D	sdmcr
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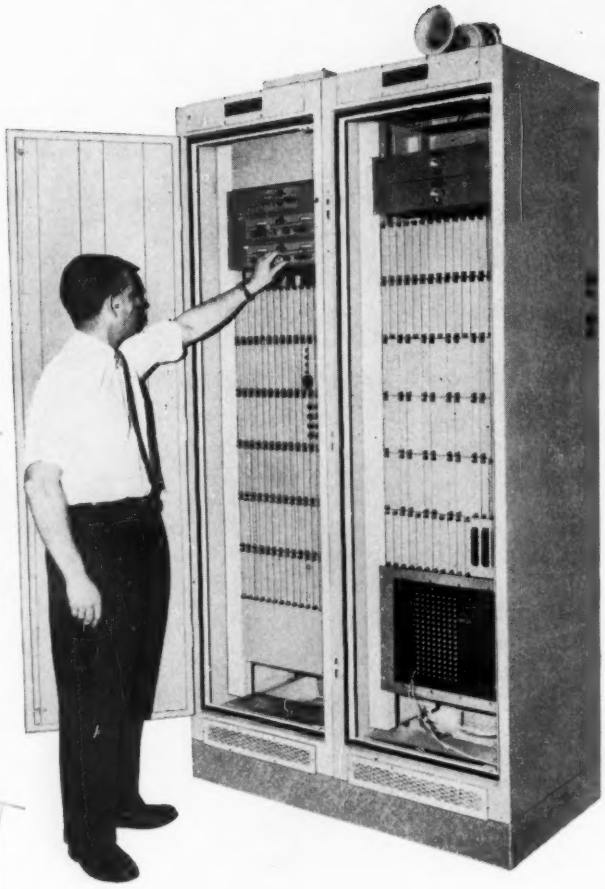

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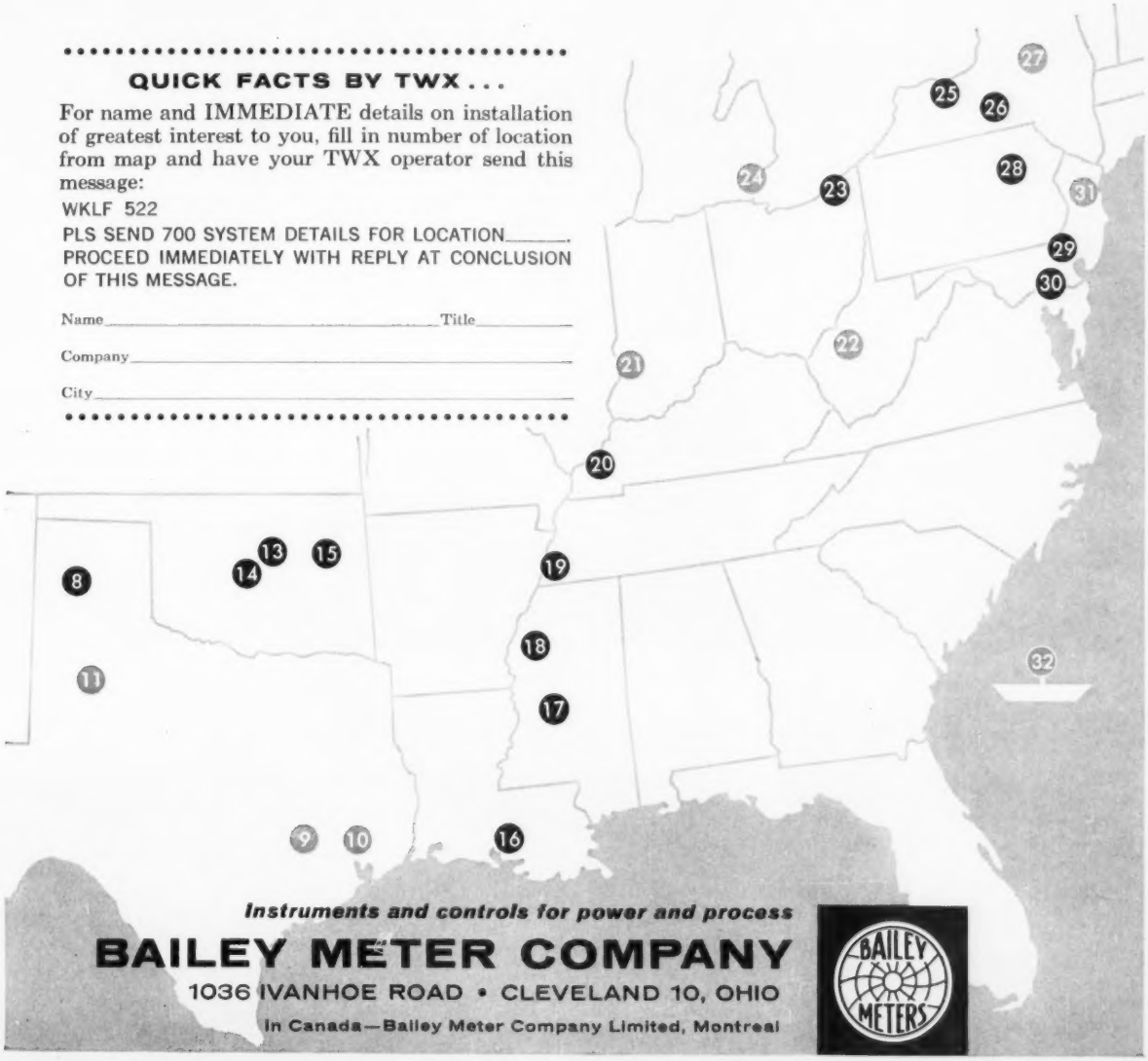

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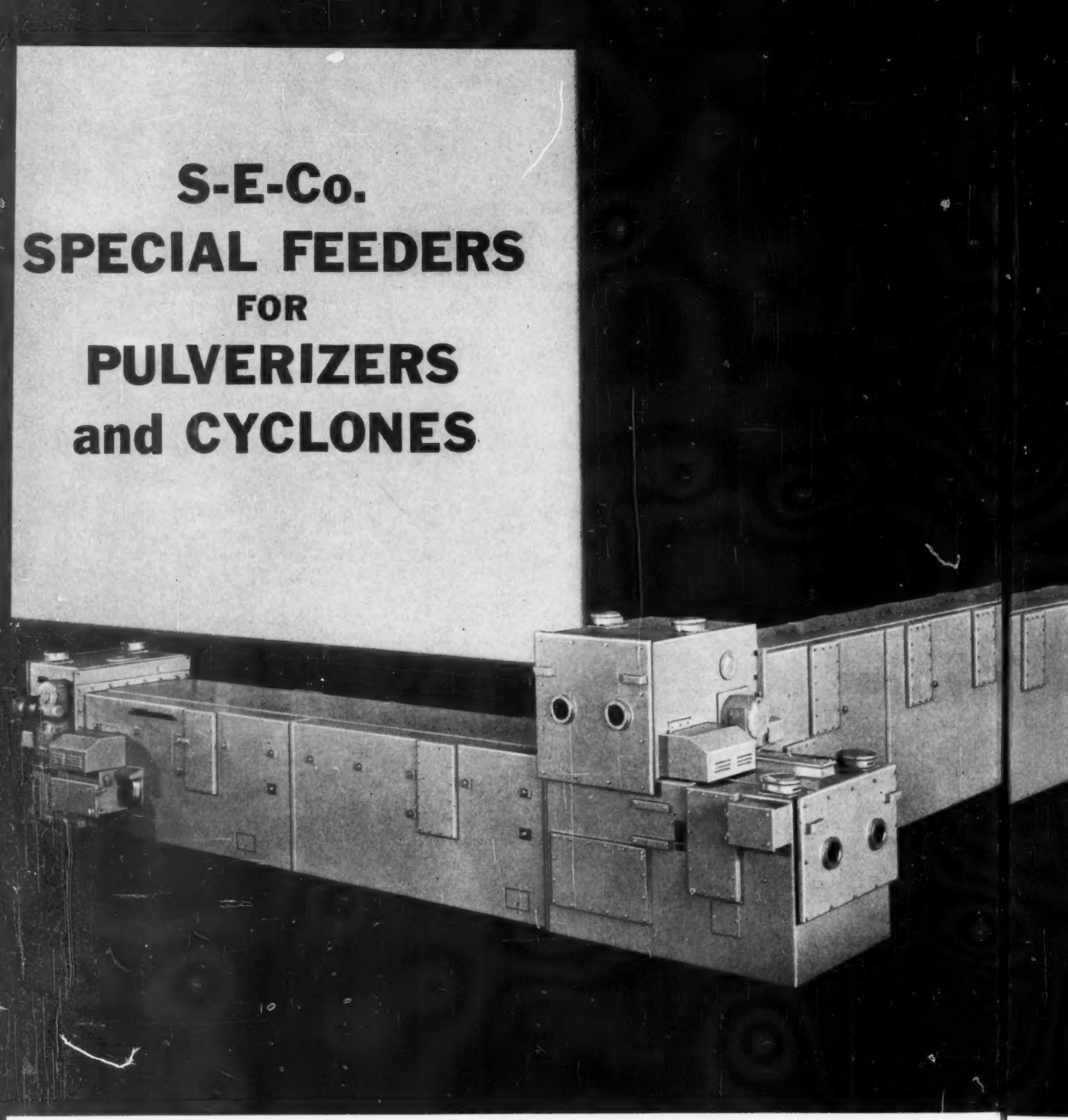

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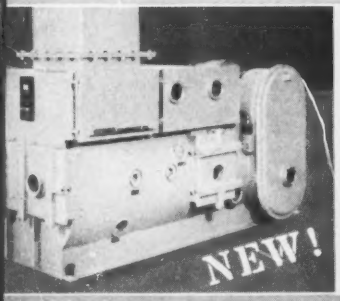
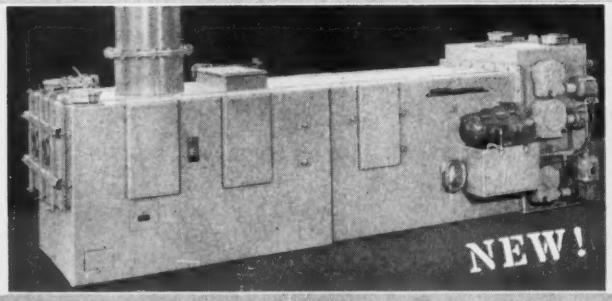
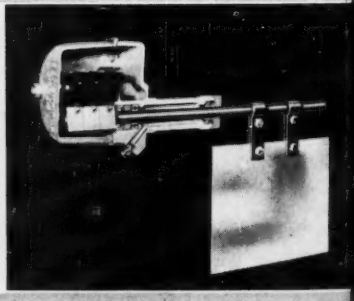


GRAVIMETRIC FEEDERS
Weigh and Feed

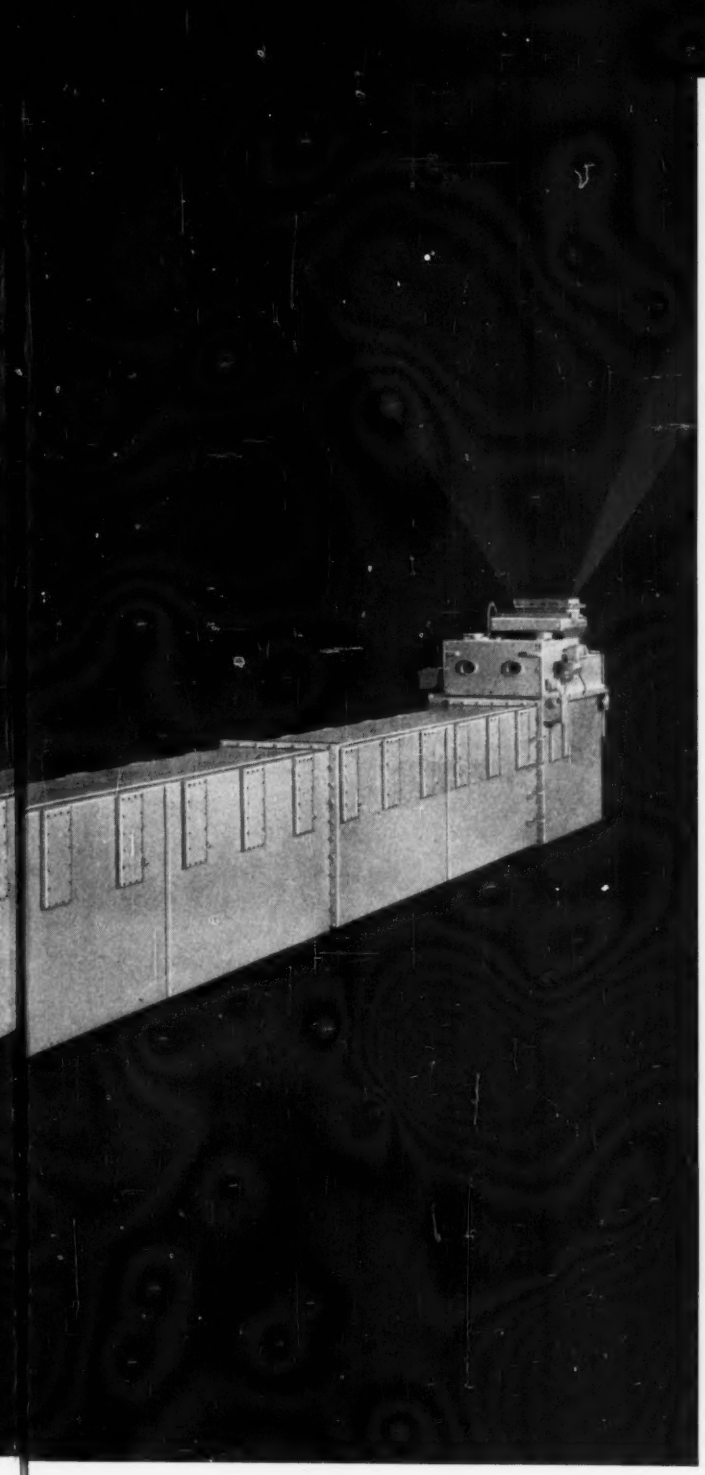


VOLUMETRIC FEEDERS
Feed Sticky Coals



STOPPAGE ALARMS
Two Types

CO



STOCK EQUIPMENT COMPANY builds special volumetric and gravimetric feeders for pulverizers and cyclones. The feeder shown in the illustration is an L-shaped unit that carries coal approximately 65′ down the side of the boiler and then brings it in about 20′ to a cyclone burner. Units of this type allow a furnace to be fired from both the front and the rear and at the same time have a coal bunker on the front side only.

Feeders can be made almost any length and they can be double-decked, operated under vacuum or under pressure, and otherwise designed to suit requirements of purchaser's plant.

S-E-Co. Feeders are all equipped with endless rubber belts to assure maximum belt life and the best possible reliability. The width of the coal on the belt is 24″, and the feeder inlets are standard 24″ square or 24″ in diameter. This means fine, wet, sticky coal will feed with maximum reliability.

S-E-Co. Feeders are driven with a constant speed motor through a magnetic slip clutch to give the variable coal feed rate desired. A tachometer on the output shaft supplies a feedback signal into the motor control to balance the incoming signal and thus assure the feeder discharge rate corresponds exactly to the coal demand. There is nearly zero hysteresis in the system.

Send your problem feeder jobs to

STOCK EQUIPMENT COMPANY

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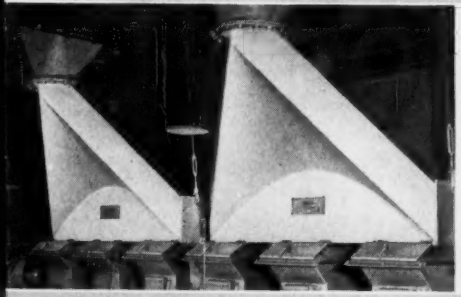
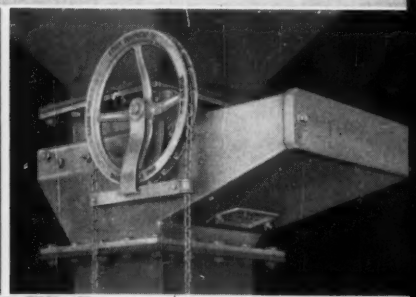
S-E-Co. QUALITY PRODUCTS

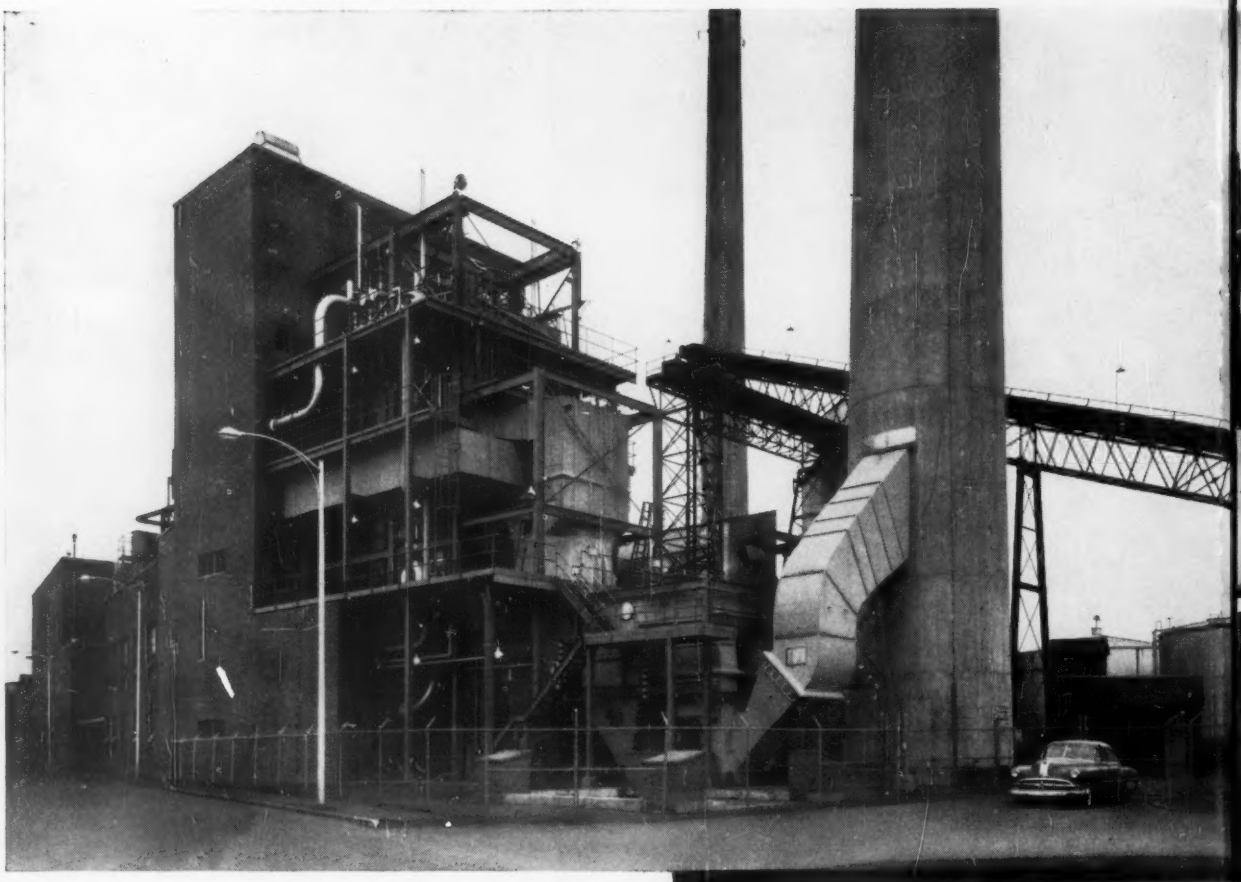


CONICAL NON-SEGREGATING
COAL DISTRIBUTORS

COAL SCALES
Two Basic Sizes

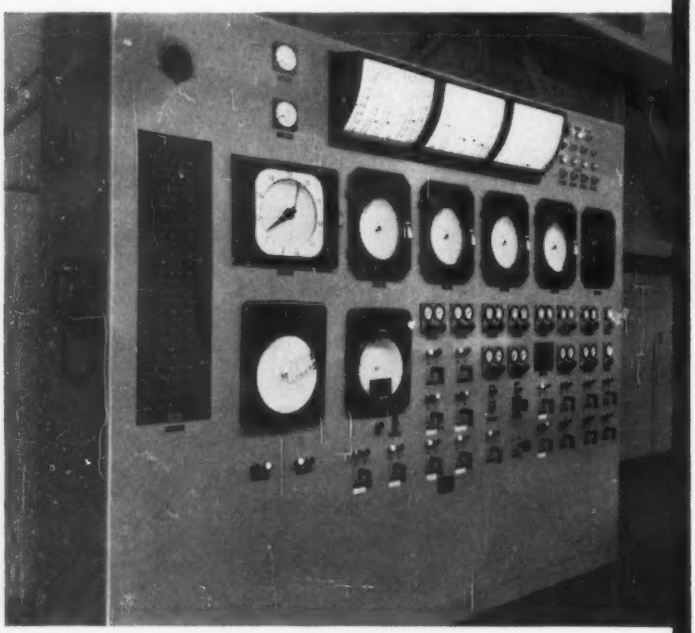


COAL VALVES
6″ to 60″ — Many Styles

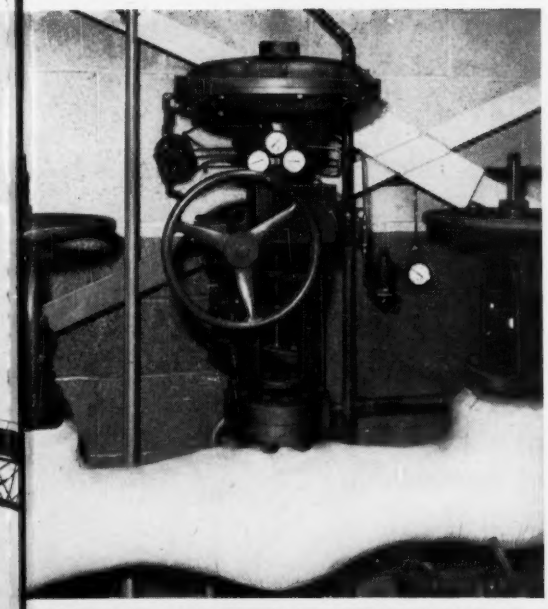


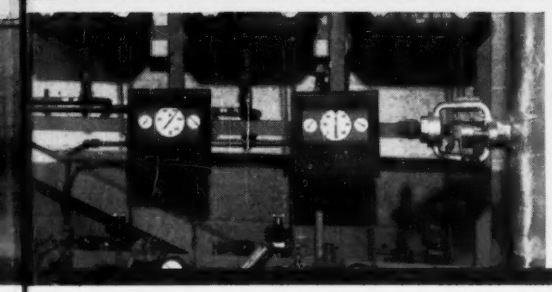
Except for the firing aisle and control room, Boiler Unit 7 is outdoors and subject to sub-zero temperatures. The unit delivers steam at 850 psig and 900°F to a 16,500-kw turbine-generator installed in the tall building (left) some 200 feet away.

Copes-Vulcan boiler control automatically balances output with demand at Taunton Plant



Eleven miniature Copes-Vulcan stations on this operating panel provide remote control of all processes with automatic-to-manual, or manual-to-automatic selection, with "bumpless" transfer. Automatic and manual loadings can be matched perfectly without going through a seal or reset position.





Diaphragm-type control valve (upper left) is used with Copes Type 3-L feedwater control. The valve features positioner, air lock, and side-mounted handwheel for emergency operation.

Designed for superior accuracy and long range dependability, Copes-Vulcan valves establish new standards of efficiency for pressure, temperature, flow, and level control.

Two versatile regulator valves are available for pressure standards from 125 through 2500 pounds. Diaphragm-type CV-D is designed for remote control service, can be direct or reverse acting, features excellent rangeability. Piston-type CV-P is designed for high-duty service, assures maximum power with precise positioning. **Write for Bulletin 1027.**

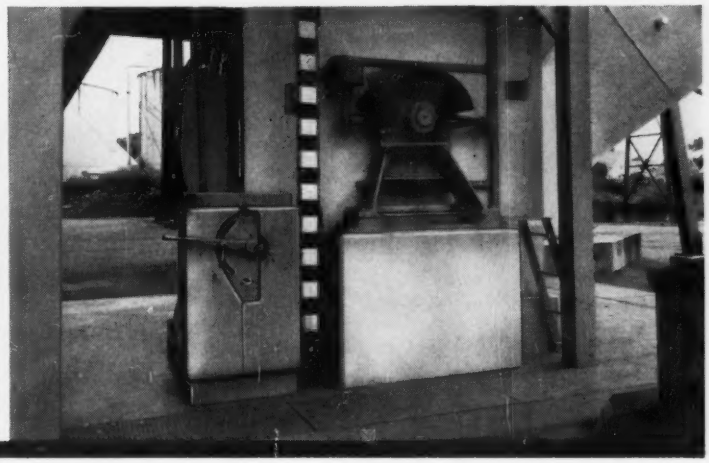
The two field mounted Copes-Vulcan indicating pressure transmitters (lower left) are used for feedwater (left) and fuel oil (right). Proportional action with pneumatic feedback is ideal for pressure-regulating service.

Copes-Vulcan transmitters feature good repeatability. Standard output pressure is 3 to 15 psi for input bands of 1 to 100%. Outputs of 6 to 30 psi and 12 to 60 psi are also available. **Write for Bulletin 1036.**

Drive unit (right) for the inlet damper of the induced-draft fan is installed at ground level outdoors. Insulation, used for protection against adverse weather, is easily removed for inspection and maintenance of the unit.

Copes-Vulcan Drive Units permit remote positioning by automatic or manual signals. They may have linear, square, or square-root characteristics, or may be field-characterized.

Five models are available. All have 90-degree angular rotation and may be manually operated by a handwheel. **Write for Bulletin 1033.**



The Municipal Lighting Plant in Taunton, Massachusetts, selected Copes-Vulcan to provide Unit 7 with precision boiler control. Featuring simplicity of circuits and dependable accurate components, the Copes-Vulcan system automatically maintains a constant main steam-header pressure under varying demands. Peak loads reach 170,000 pounds per hour. Operation remains under fully automatic control down to 40,000 pounds per hour.

Unique combustion control includes skillfully designed circuits for fuel-loading report-back and fuel cut-back. Other controls assure constant furnace pressure, the correct ratio between steam flow and air flow, and a practically constant drum water level.

Temperatures and pressures regulated. Air-heater temperature, mill pressure, and steam temperature at the superheater outlet are accurately managed.

A complete line—a complete service. In addition to boiler control, the Copes-Vulcan line includes complete systems for fully automatic soot blowing, pressure reducing, and desuperheating. All are custom engineered. All are backed by more than 50 years of design experience.

Whether your boiler be large or small, power or process, Copes-Vulcan can provide a unit or a coordinated package to meet your requirements.

For the complete story, write for Bulletin 1065. Copes-Vulcan Division, Erie 4, Pennsylvania.

Copes-Vulcan Division

BLAW-KNOX

For more facts circle 210 on Reader Service card, p 99

SARCO TOPICS

HOW TO PREVENT FREEZING OF HEATING COILS

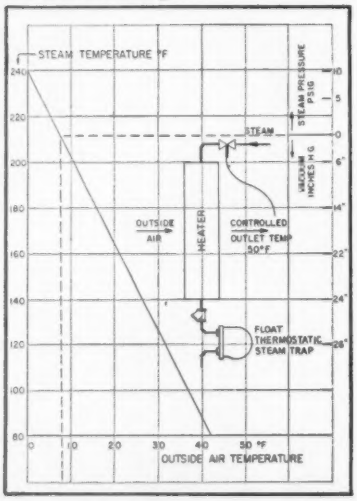
Despite the *best* "non-freeze" construction, air heating coils handling incoming air even slightly below 32° F are subject to freezing—*if they're not properly drained.*

Are traps to blame?

Under such conditions it is easily assumed that steam trap capacity is inadequate. However, there are other, more likely reasons. Since the discharge capacity of a steam trap depends upon the pressure differential between trap inlet and outlet, a zero pressure difference will result in zero capacity, no matter how large the valve seat is.

Why coils freeze

If the pressure at the trap inlet falls lower than pressure at the outlet, condensate cannot be discharged and will be held back in the coil. Condensate held in the coil is bound to freeze if the temperature of the air is below 32° F. As an example, consider a preheat coil designed to heat air from 0° F to 50° F, using steam at a maximum pressure of 10 psig. The chart below indicates that, as the outside air temperature rises above 0°F, the heat demand decreases, the temperature *controller reduces the steam pressure* to compensate for this reduced heat demand—and the stage is set for coil freezing.



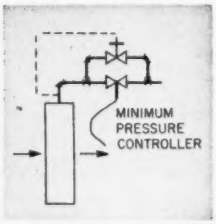
At left: chart shows how steam pressure in the heater is decreased by the modulating control as outside air temperature increases. Note that when outside air temperature reaches 7° F the pressure drops to 0 psig. In other words, unless special provisions are made there will be no pressure difference across the steam trap.

The remedy: 3 practical hook-ups

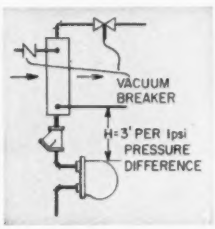
Starting with a correctly sized steam trap—and the Sarco Float Thermostatic is recommended as best suited to this type of application—freezing can be cured by preventing the pressure differential across the trap from falling below the minimum needed to discharge all the condensate as rapidly as it forms. Here are three practical methods.

1. Arrange a pressure controlled bypass around the temperature control valve

This keeps the pressure in the heater from falling below a preset minimum. With this solution, however, the temperature controller is not effective over the full range of outside air temperature.



Schematic hookup for pressure controlled bypass around temperature control valve.



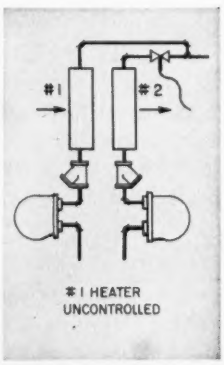
Hookup for installing steam trap below unit.

2. Install the steam trap well below the unit

This provides a hydraulic leg which allows the trap to discharge even with a vacuum in the steam space. A vacuum breaker should be installed at the top of the condensate header of the heater. To calculate the hydraulic head needed, use 3' per 1 psi pressure differential. Example: if trap has required capacity at 1 psi differential, minimum head is 3'.

3. For a new installation, divide the preheater into two sections

The first section should be capable of raising the air to at least 32° F under minimum outside air conditions and the second to raise the air from 32°F to the final temperature. The first coil would be supplied with steam at full pressure at all times, while the second would be controlled to maintain the final temperature needed. The first coil could not freeze because of steadily maintained pressure, and the second would not freeze because the air temperature would be above 32° F.



Hookup for dividing preheater into two sections.

3256

FIGURE IT OUT AT A GLANCE. "FREEZING POINT DANGER KIT" — FREE. Contact your Sarco Sales Representative, or write

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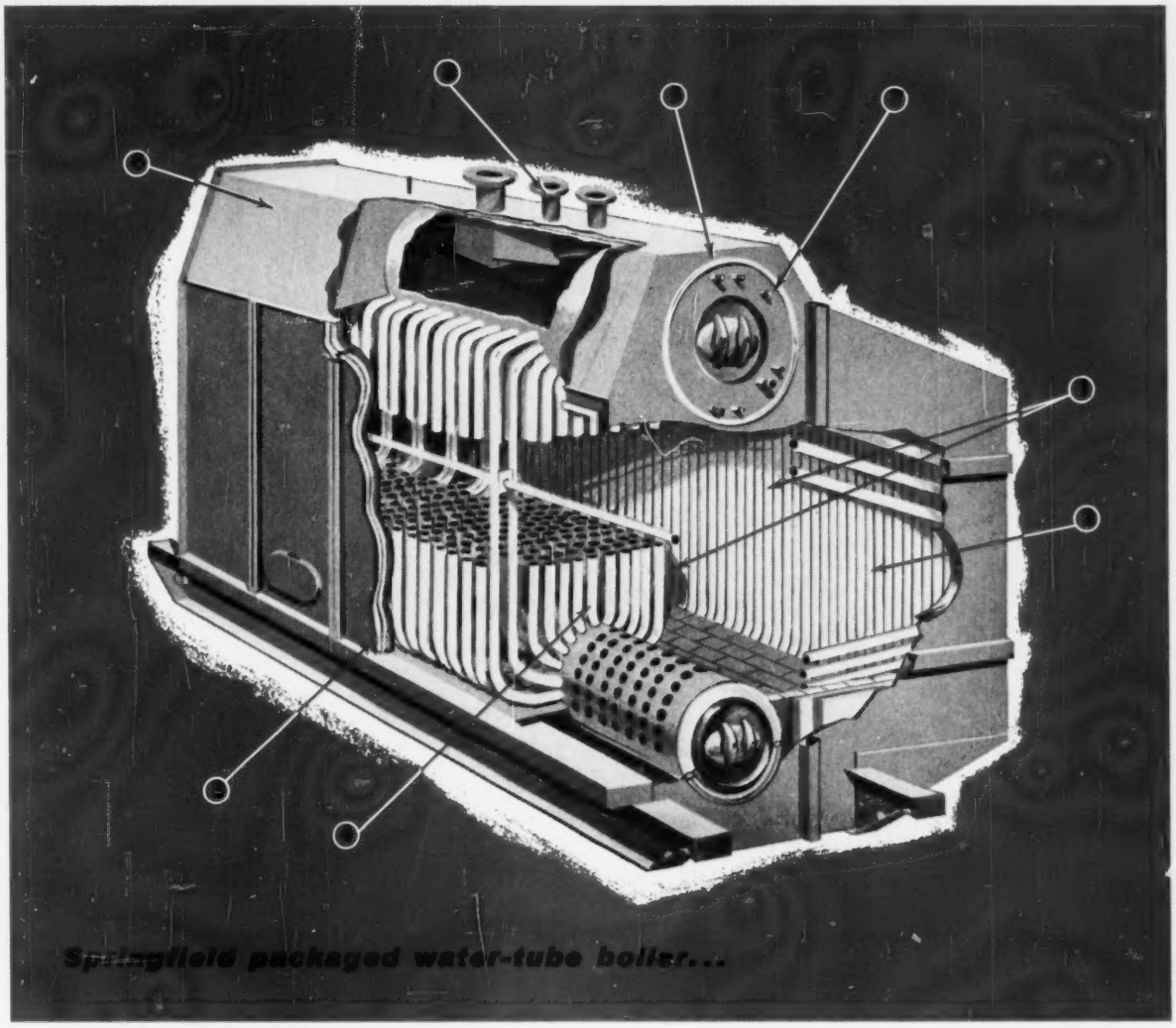

THE ONLY ONE WITH ALL TEN

1. **SOLID WALLS OF WATER.** Tangent tubing in the Springfield provides "solid walls of water" on four sides of the furnace — the maximum heat-absorbing surface that can be applied to these areas.
2. **SIX-WALL FURNACE COOLING.** Water tubes on all surfaces — top, bottom and four sides — receive the heat. This keeps casing temperature down. A double row of tubes protects the rear wall of the furnace.
3. **INSULATED DOUBLE-STEEL CASING.** First applied on packaged boilers by Springfield, this double casing eliminates the need for refractory material in the side walls often necessary in other makes of boilers. Result — no refractory maintenance.
4. **MOST EFFECTIVE TUBE ARRANGEMENT.** Staggered tubes in the convection zone direct hot gases into a turbulent pattern for maximum heat transfer. Wide/narrow rows provide full accessibility to every water tube.
5. **UPPER DRUMHEADS FULLY INSULATED.** Another job-site expense item eliminated. Factory-applied casing covers drumheads. You avoid the cost of field-applied insulation.
6. **A MANWAY IN EVERY DRUMHEAD.** Springfield stresses operator safety with these extra manways for maintenance, inspection and cleaning — included at no extra cost to you.
7. **WELDED, GASTIGHT EXPANSION JOINTS.** Another Springfield original and exclusive feature. These unique, fully welded expansion joints absorb both horizontal and vertical expansion stresses — eliminate costly casing maintenance.
8. **UNIQUE STEAM SEPARATOR.** Developed by Springfield engineers for large central station boilers, then adapted for the "D" type boiler, this steam separator assures continuous dry steam for the life of the boiler.
9. **TOTAL BOILER SERVICE.** Your boiler investment is safeguarded by service that begins with advanced design and engineering, through factory testing, and carries through to factory-authorized starting service to assure you of maximum operating efficiency.
10. **TOTAL BOILER EXPERIENCE.** Springfield's 70 years of experience in the water-tube boiler field plus Cleaver-Brooks' leadership in the packaged fire-tube boiler field are back of every boiler produced, every recommendation made. You can contact Cleaver-Brooks, with confidence, for answers to *any* boiler problem.

We offer packaged water-tube boilers and field-erected units to meet your required capacities.

SPRINGFIELD

BOILER COMPANY

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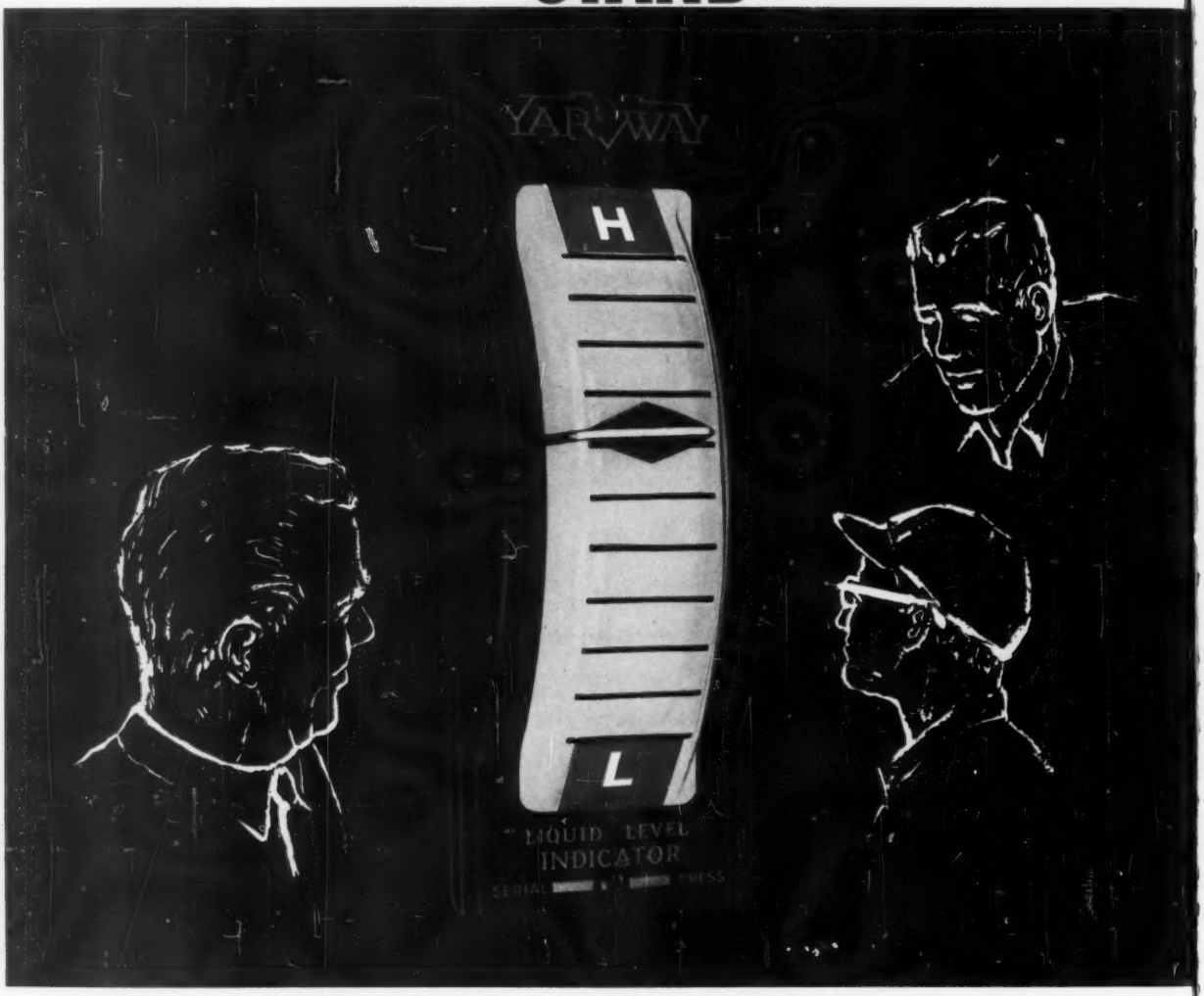
For more facts circle 212 on Reader Service card, p 99

WHERE DO YOU STAND ON BOILER



TYPICAL USERS OF YARWAY INDICATORS FROM OVER 15,000 INSTALLATIONS

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FORD MOTOR COMPANY
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UTILITIES

(Code Case #1155 Installations)

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IOWA ILLINOIS GAS & ELECTRIC
CENTRAL ILLINOIS PUBLIC SERVICE
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LAKE SUPERIOR DISTRICT POWER
NORTHERN STATES POWER CO.
PUBLIC SERVICE OF INDIANA
INDIANAPOLIS POWER & LIGHT
IOWA ELECTRIC LIGHT & POWER
NEBRASKA POWER
NEW ENGLAND POWER
ROCHESTER GAS & ELECTRIC CO.
PENNSYLVANIA ELECTRIC CO. (ERIE, PA.)
OMAHA PUBLIC SERVICE
CENTRAL ILLINOIS ELECTRIC
NARRAGANSETT ELECTRIC CO
LOUISIANA POWER & LIGHT
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WATER LEVEL INDICATION ?

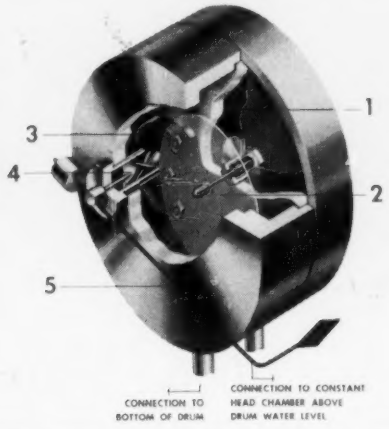
YARWAY REMOTE INDICATORS HAVE BRILLIANT "WIDE ANGLE" VISIBILITY... CAN BE INSTANTLY READ FROM MULTIPLE VANTAGE POINTS

Yarway Remote Liquid Level Indicators bring distant, often hard-to-see boiler level readings right down to eye level on the panel board or other convenient location.

No matter where you stand—at any point in a 180° arc, and from a considerable distance—the brilliant new wide vision dial makes viewing and reading easy.

GIVE INSTANT, ACCURATE READINGS BECAUSE INDICATOR IS OPERATED BY THE BOILER WATER ITSELF

Remote readings of levels in boilers (also feed water heaters and other heat exchangers) are instant and accurate because indicator *operating mechanism* is actuated by the varying head of the liquid itself, yet the *pointer mechanism* is never under pressure.



Constant pressure from a controlled-temperature constant head chamber located above drum level is maintained on one side of diaphragm (1) in indicator. Varying pressure changing with water level is maintained on opposite side of diaphragm. Change in differential between the two pressures moves the diaphragm which in turn regulates, through deflection plate (2), magnet (3), and spiral magnetic armature (4), the position of the counterbalanced pointer (5).

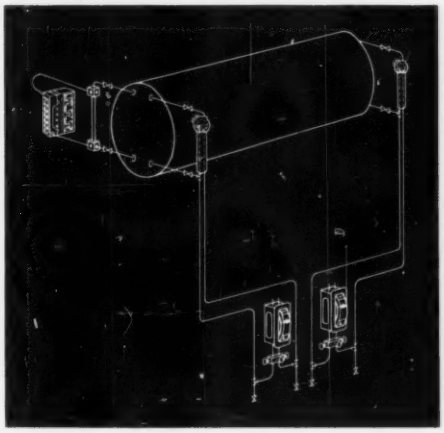
OPERATE ADDITIONAL REMOTE SIGNAL ALARMS, HORNS OR LIGHTS

With the addition of a control unit Yarway Indicators may be equipped to operate auxiliary hi-lo signal alarms, horns or lights located at any place in the plant. Electronic secondary indicators may also be used to duplicate readings at remote points.

FULLY APPROVED AS PRIMARY INDICATING ELEMENTS UNDER BOILER CODE CASE #1155

Under A.S.M.E. Boiler Code Committee ruling in Case #1155, two independent remote level indicators of compensated manometric type may be used instead of one of two required gage glasses for boiler pressures 900 psi and above. When both indicators are in operation, the gage glass may be shut off but shall be maintained in serviceable condition.

Yarway Remote Liquid Level Indicators conform to this ruling and are used widely for primary boiler water level indication in plants operating at 900 psi and above.



All Yarway Indicators for service over 700 psi are temperature-compensated; pressure compensation available when desired. Use of controlled-temperature column on constant head chamber fully protects against system upsets.

If you would like a reprint of this Boiler Code ruling, just ask for Case #1155 reprint.

Get the full story on Yarway Liquid Level Indication for your plant. Write for new 24-page Bulletin WG-1825.

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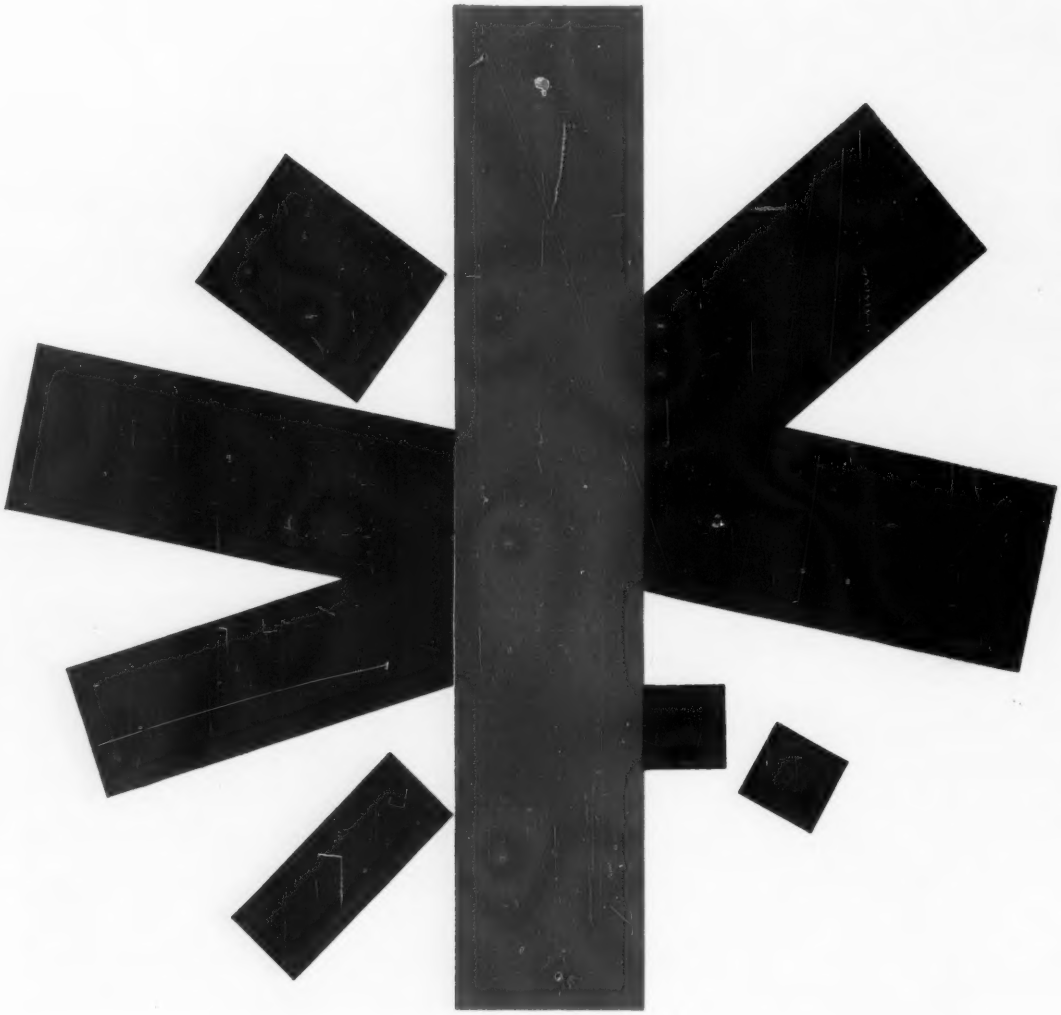
A MARK OF QUALITY IN STEAM ENGINEERING

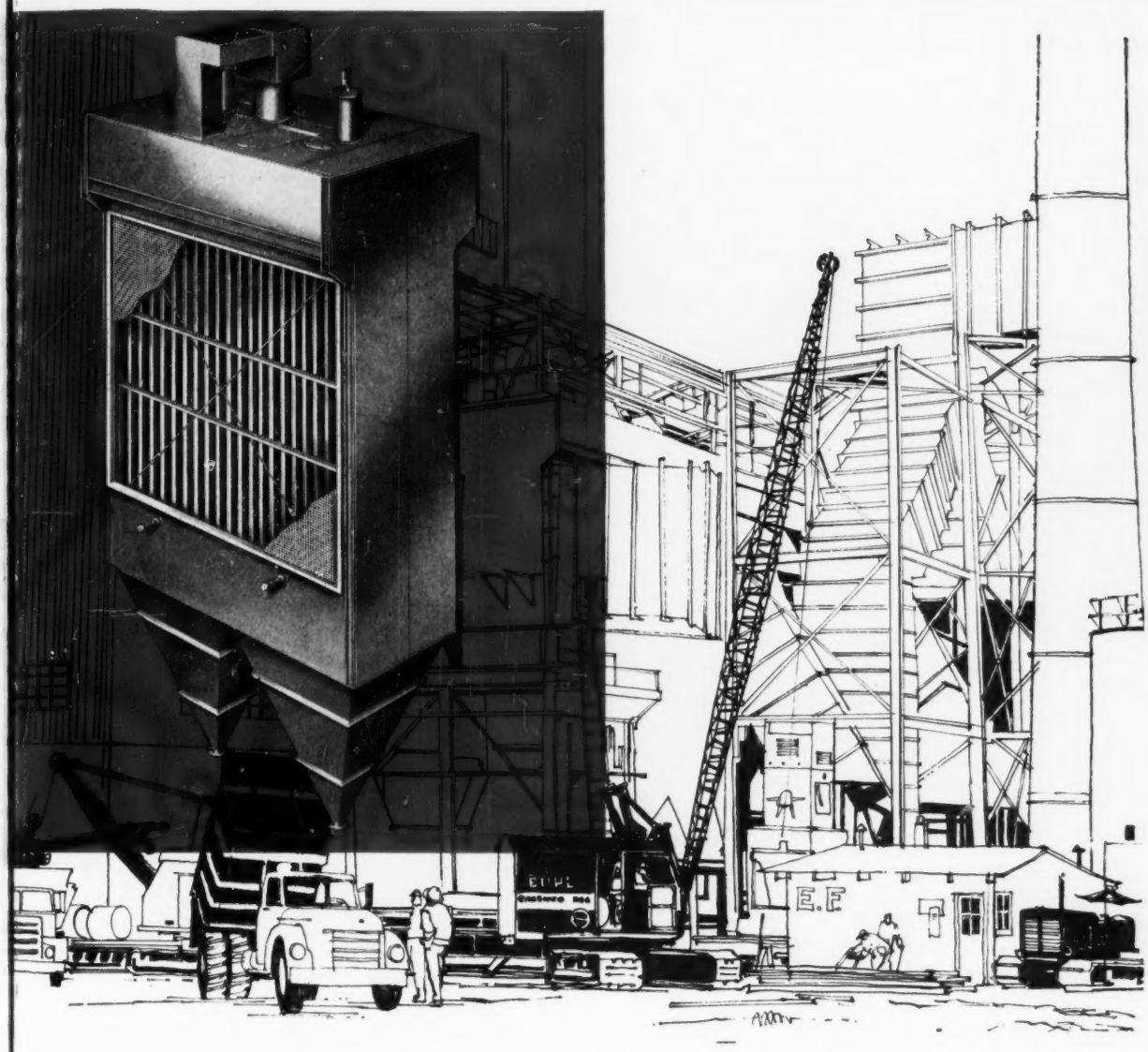
POSITIVE COLLECTOR PLATES ATTRACT NEGATIVE DUST PARTICLES



improved collector plate design, factory pre-assembly that cuts field erection time, improved pneumatic or electric rapping, automatic voltage control, choice of high-voltage rectifiers

This is the new electrostatic

One of the most important features of our new electrostatic precipitator is the unique new collector plate. It is a flat plate to which we have added a "pocket" that traps dust, and reduces the chance of reentrainment. The new design also improves clean-plate sparking voltage, increases the migration velocity of particles, performs better with high



precipitator from American-Standard Industrial Division!

resistivity dusts, and makes rapping much easier. The choice of rapper is up to you; we offer both pneumatic and electric types. So is the choice of rectifier . . . silicon, selenium, high-voltage vacuum, or mechanical. Automatic voltage control is standard with all units. Factory pre-assembly is carried to the limit of practicality. Case in point: Structural frames, side casing, end panels, and hoppers arrive ready to drop in place. The result is faster, less costly field erection. For detailed information, call our nearest sales office and talk with one of our product specialists. American-Standard Industrial Division, Detroit 32, Mich. In Canada: American-Standard Products (Canada) Limited, Toronto, Ontario.

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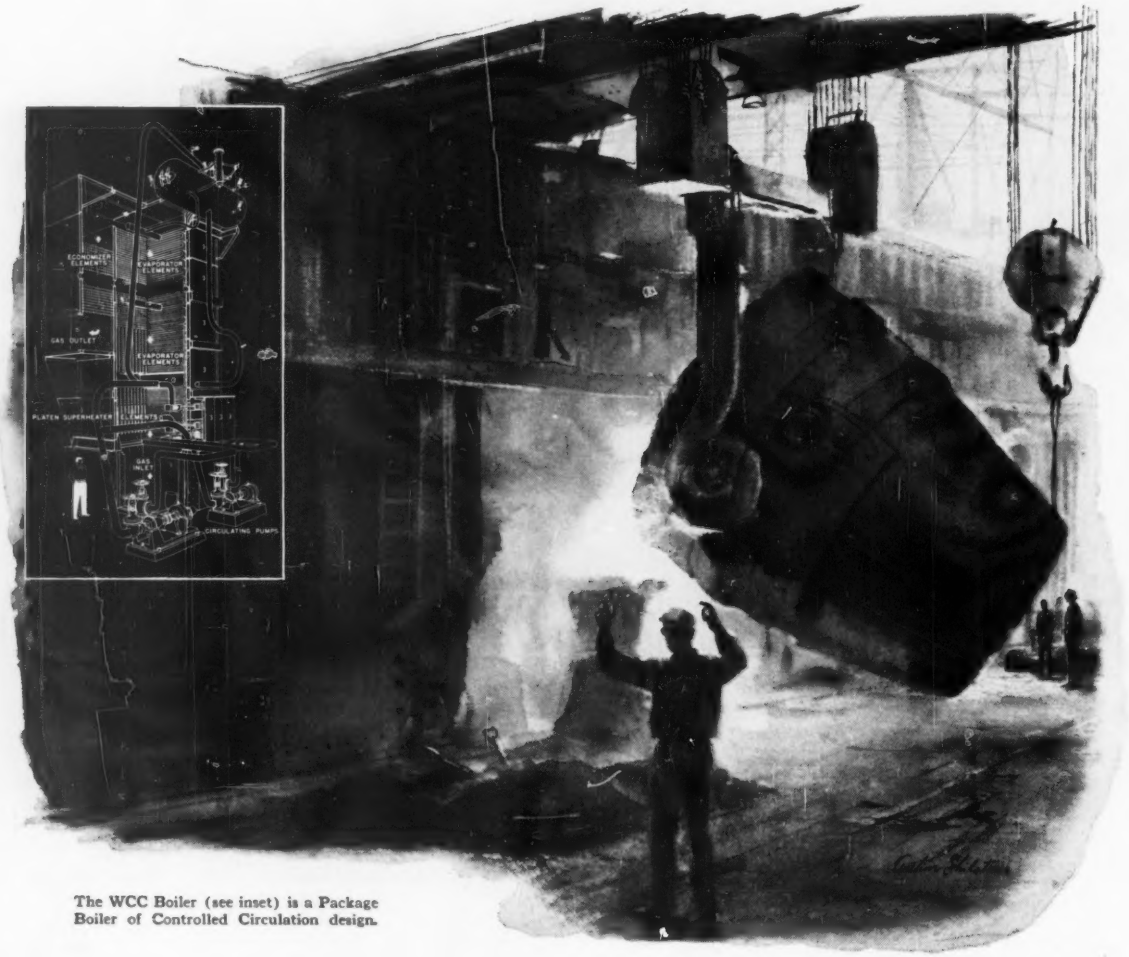
WASTE HEAT AND BY-PRODUCT STEAM WHEN

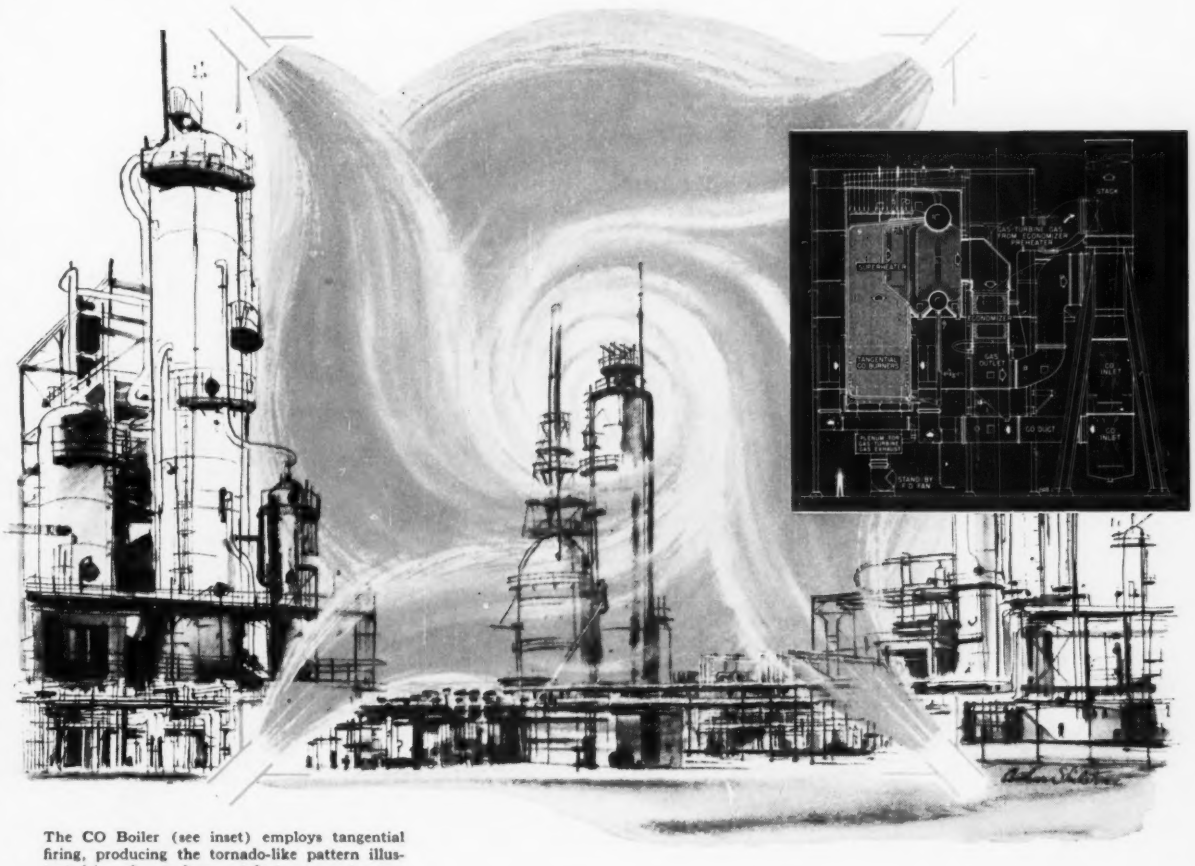
Though no two industrial processes are exactly alike, a great many produce hot waste gases or by-product waste materials. Often, they contain substantial amounts of energy which, when properly used, can provide a valuable addition to the fuel supply of a plant. C-E has had long and varied experience in taming and harnessing many kinds of waste and marginal fuels. At the steel mill pictured below and in refineries like the one at right, C-E boilers use just such fuels to provide dependable, low-cost steam.



The WCC Boiler (see inset) is a Package Boiler of Controlled Circulation design.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

MATERIALS PROVIDE LOW-COST HARNESSED BY C-E



The CO Boiler (see inset) employs tangential firing, producing the tornado-like pattern illustrated in color, to burn catalyst regenerator gas.

As discussed on the opposite page, two interesting examples of waste heat "in harness" are the applications of specially designed C-E boilers to the exhaust of steel mill open hearth furnaces and to the catalyst regenerator exhaust of a refinery. In each case, the gases used are peculiar to the industry involved. In one instance, they are sticky and corrosive and offer only sensible heat. In the other, the gases are toxic and moist, and contain a lean measure of chemical heat in the form of carbon monoxide—in addition to sensible heat. In both cases, C-E advanced engineering has created boiler designs (see sketches) ideally suited to the heat source—boilers which provide maximum steaming capacity with minimum maintenance. Other C-E boiler designs in the waste heat category are in service using a wide variety of waste process gases — with and without chemical heat. In the area of marginal and by-product fuels, C-E has designed and placed in service a large number of boilers which burn such wastes as refinery sludge, wood shavings, sawdust, pith, rice and oat hulls, furfural waste, bagasse, peanut shells, grape skins, spent coffee grounds, black liquor and, of course, coke oven and blast furnace gas.

What all this adds up to is the fact that there is really no such thing as waste heat—there is only *wasted* heat. And there needn't be—because Combustion has the know-how and experience to put almost any potential energy source to work for you—to provide you with an extra dividend in the form of additional low-cost steam for your plant. Why not investigate harnessing a C-E boiler to your waste heat or by-product material? The amount of money it can save for you may be surprising.

COMBUSTION ENGINEERING

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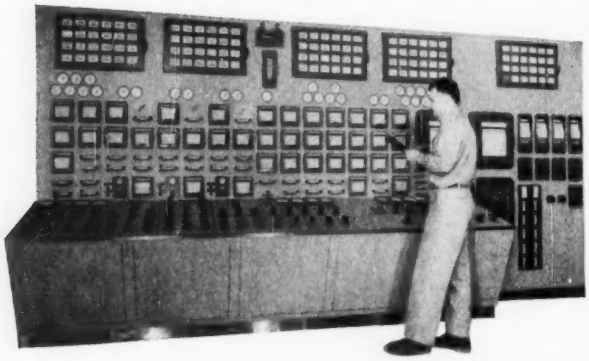
(Advertisement)



Foxboro control console . . . designed and built as a single unit — for Public Service of New Hampshire, Bow Station

a bold concept in central station instrumentation

Central station control room panels have looked pretty much the same in generating stations built in the past decade. Now, The Foxboro Company introduces a dramatic new concept in control room instrumentation.

Called the "Consotrol Approach," the new system blends the separate instrument panel and the separate operator's console into a single, integrated operating unit. The expense of transmitting variables to the panel *and* to the console is eliminated; control room size is reduced; plant operation is simplified.

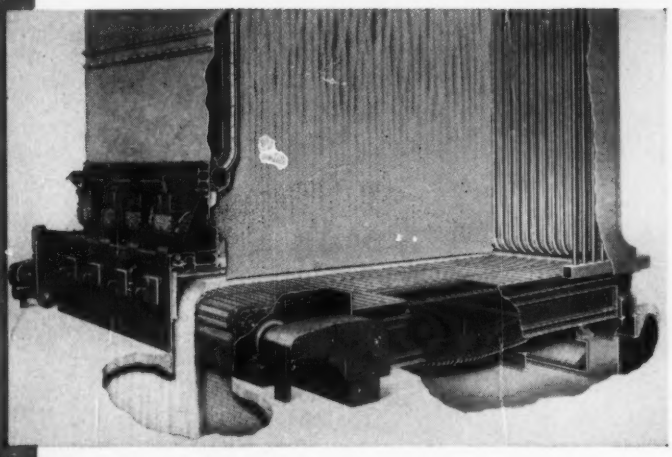
But what makes the new system really pay off is its use of small-case Consotrol* electronic and pneumatic recorder-controllers. These unique Foxboro instruments are so compact that *four* can be mounted in the panel space required for a single large-case recorder. Result: control panels which would normally run up to 50 feet in length, can now be erected in a fraction of the space — and at a fraction of the cost.

At a time when instrument outlay accounts for as much as 10% of new construction costs, the Foxboro Consotrol Approach is particularly worthy of close Industry investigation. For more complete details write The Foxboro Company, 681 Neponset Avenue, Foxboro, Massachusetts. Ask for Bulletin 1-17.

*Reg. U.S. Pat. Off.

63% REPEAT ORDERS *for* DETROIT ROTOGRATE STOKERS

During a 5 year period, our sales records show that 63% of the RotoGrate Stokers sold, went to customers who were already using RotoGrates.



can there be any question of how these customers feel about ROTOGRATE performance?

SOME OF OUR REPEAT CUSTOMERS:*

Allied Chemical Corp.	International Paper Co.
American Motors Corp.	Johns-Manville Corp.
Atomic Energy Commission	Kimberly-Clark Corp.
Black Hills Power and Light Co.	Minnesota Mining and Manufacturing Co.
J. I. Case Company	Monsanto Chemical Co.
Caterpillar Tractor Co.	Ohio State University
Central Illinois Electric and Gas Co.	Southern Colorado Power Co.
Chrysler Corp.	Southern Utah Power Co.
Ford Motor Company	Vineland (N. J.) Municipal Utility Plant
General Electric Co.	W. Virginia Pulp and Paper Co., Inc.
General Motors Corp.	
Indianapolis Power and Light Co.	

*Our apology to the many others not mentioned due to space limitation.

DETROIT STOKERS SINCE 1903

DETROIT STOKER COMPANY
DIVISION OF UNITED INDUSTRIAL CORPORATION
MAIN OFFICE AND WORKS • MONROE, MICHIGAN
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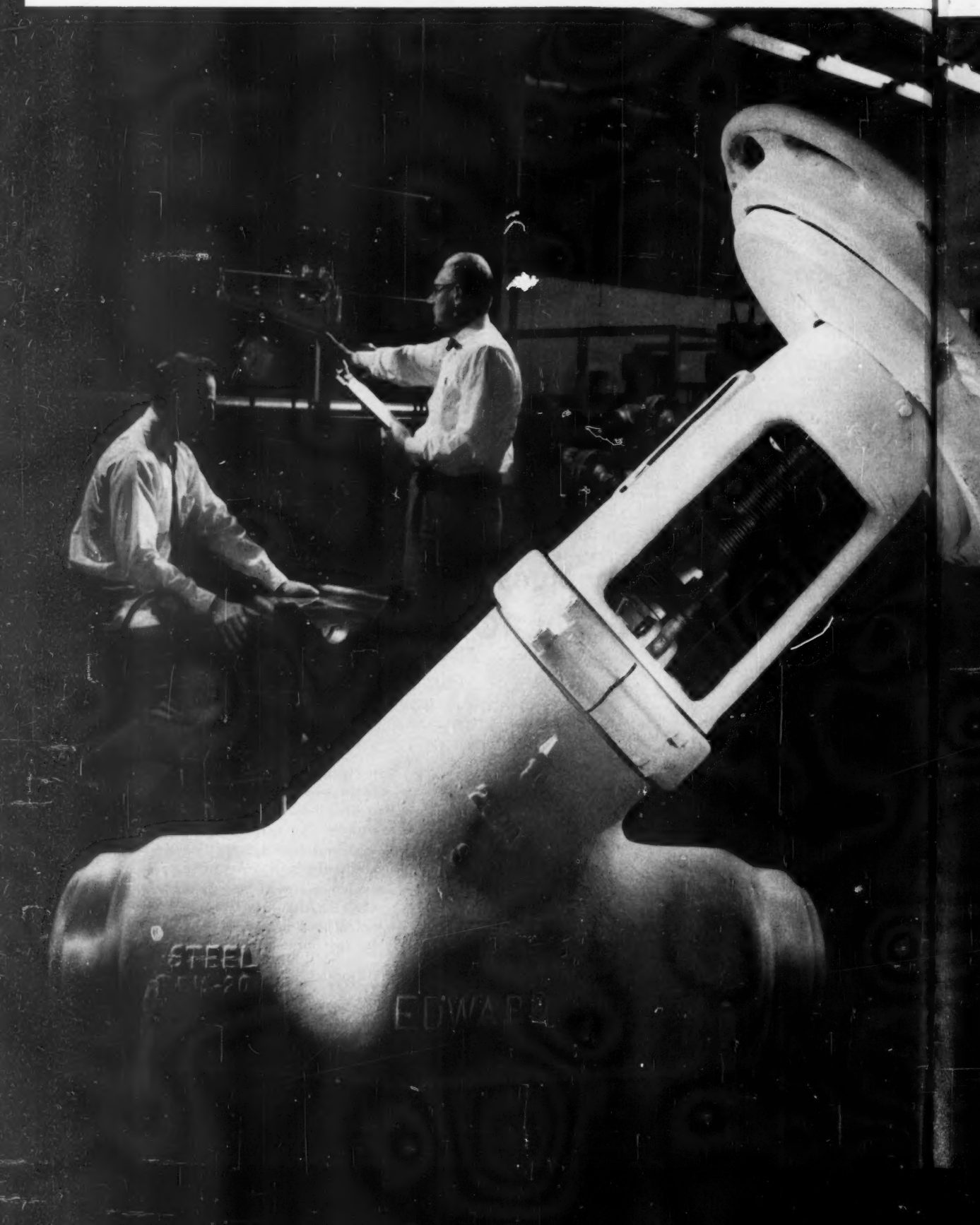
DETROIT ROTOGRATE STOKERS SERVE BOILERS AND STEAM GENERATORS WITH CAPACITIES OF UP TO 400,000 POUNDS OF STEAM PER HOUR.

EFFICIENT	Low combustible loss — Low excess air — More steam per pound of fuel.
FLEXIBLE	Handles widely fluctuating loads, easily, rapidly and without smoking.
DEPENDABLE	Exceptional availability records in all kinds of plants, year after year.
VERSATILE	Burns all grades of bituminous and lignite coals — Also many waste fuels.
ECONOMICAL	Practical design — Rugged construction for low maintenance.

For more facts circle 217 on Reader Service card, p. 99

Circle 218 on Reader Service card for following ad ➤

How Edward Valve Research.



Reduced Pressure Drop 70%

Power industry advances in unit size created a need for large, high pressure steel valves (ten inch size and larger, 1500 lb class and higher) with three basic qualities: 1. Permanent tight seating; 2. Capacity to handle high flow rates being encountered in new, high pressure plants; 3. Reduced downtime through simplified maintenance. Edward researchers developed the Flite-Flow* design to satisfy that need. This is their story.

In 1951 Edward had already developed large cast steel globe valves with excellent dependability and repairability. Long experience in building inclined stem Y-type valves in small sizes indicated that this configuration offered a more efficient flow path. Edward research engineers set out to learn whether sufficiently strong pressure containing structures might be built in the Y-type design in larger sizes. They also sought to find out if pressure drop could be reduced sufficiently to make such a valve practical for high pressure power plant services.

The project consisted of three steps:

1. INTERNAL CONTOUR DESIGN—Flow tests were conducted with a series of plastic models. Early in the testing program it was observed that flow capacity was not always directly related to the size of the opening. Reduction of turbulence proved to be even more important. This eventually led to subtle internal contour changes to pre-shape the flow before passing through the valve seat. More material was added to certain internal areas to gain additional structural strength.

2. DISK GUIDING TESTS—To compensate for the angular position of the stem-disk assembly tests were conducted to determine whether conventional three-point guiding used in vertical stem Edward valves would be adequate for the inclined stem design. Experiments suggested that four equally spaced guiding surfaces would be superior. This is important in floating disk types such as check or stop-check valves where disk-piston assembly must seat automatically.

*T.M. Reg. U.S. Pat. Off.

3. STRUCTURAL STRENGTH—The usual weakness of a Y-type pressure containing vessel received much attention. Optimum valve contour as determined by flow testing permitted use of a structural member in the flow passage at the downstream side of the seat port. This structural member provides strength exactly where needed without significant increase in pressure drop. Introduction of this segment to the valve body casting without sacrifice in pressure drop was a significant achievement.

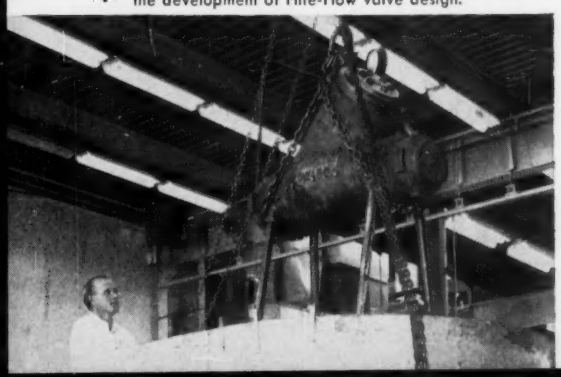
RESULTS: This program covered a period of six years. Tests of the completed design were most gratifying. Structural stability, a major problem, was excellent. Strain gage and brittle lacquer tests of finished valve bodies showed stresses well within acceptable limits. Pressure drop reduction amounted to as much as 70 per cent from best previous globe valve experience. Extended tests of finished product at pressures and temperatures above rating showed no operating weaknesses. The Flite-Flow is truly a dependable, repairable, low pressure drop valve.

Edward builds a complete line of forged and cast steel valves from ¼" to 24" for industrial, marine, petroleum and technological services. For more detailed information, contact your Edward Representative, or write Edward Valves, Inc., 1230 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 438 St. Peter Street, Montreal.

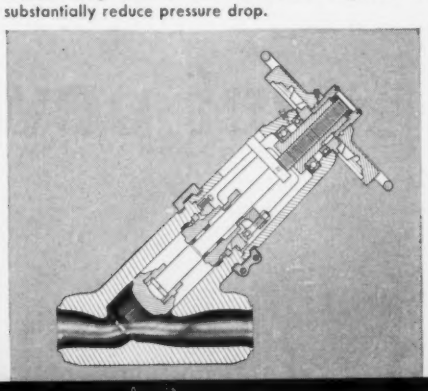
EDWARD STEEL VALVES
another fine product by
ROCKWELL

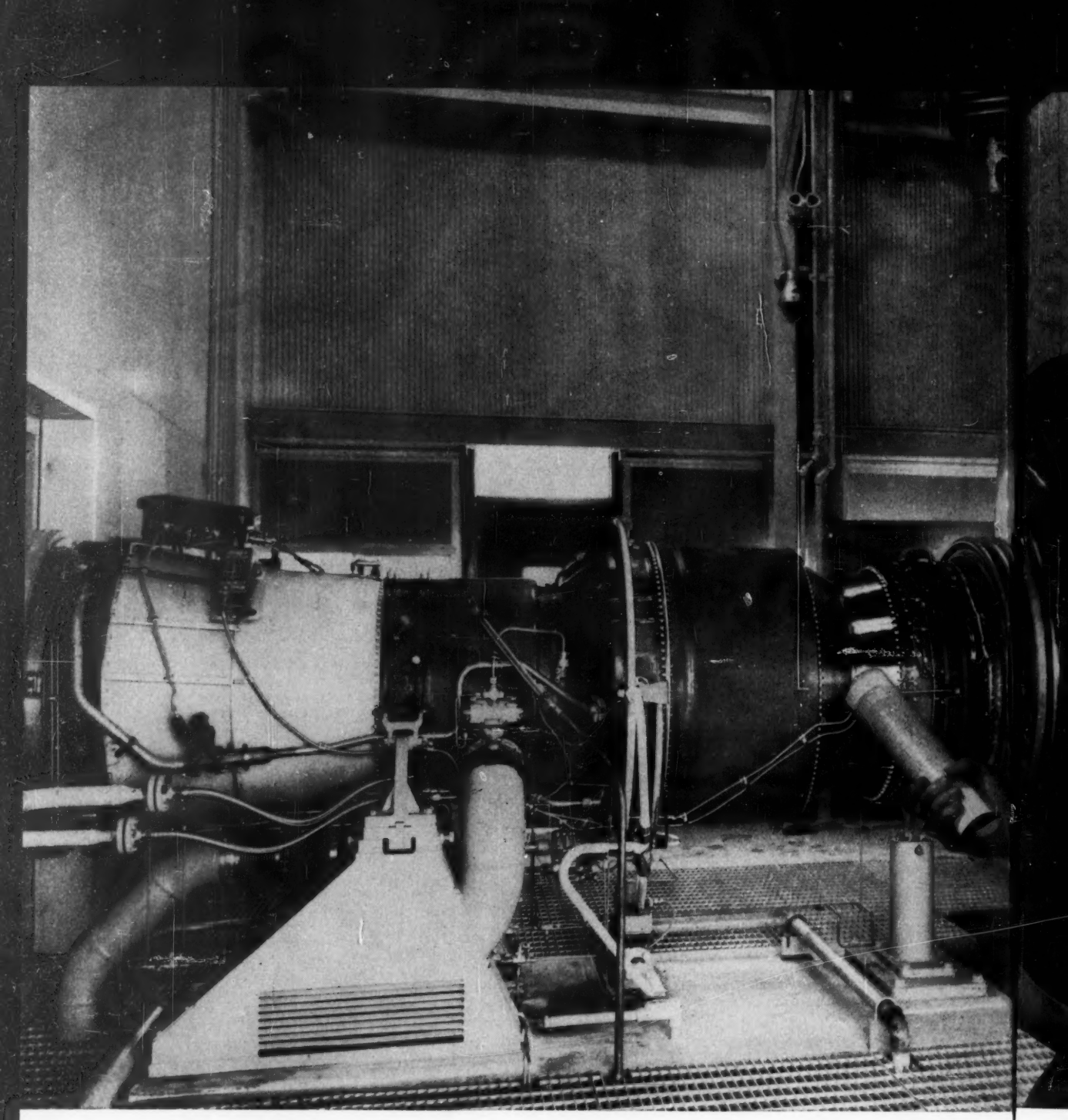
◀ **W. G. Lunt,** research engineer, and E. B. Pool, chief research engineer, study flow phenomena in plastic half-model of tentative Flite-Flow design.

▼ **Edward research team** lowers experimental valve into test furnace where it is subjected to prolonged extremes of heat and pressure. This was one of the final steps in the development of Flite-Flow valve design.



Cutaway view of Flite-Flow valve showing how inclined stem Y-type valve configuration has been adapted to larger size units for power plant services. This internal contour design enabled Edward research engineers to substantially reduce pressure drop.





R. L. Boyer, *Vice President and Director of Engineering, and* W. B. Boyum, *Manager of Gas Turbine Sales, The Cooper-Bessemer Corporation report . . .*

World's first jet powered gas turbine is now on the job

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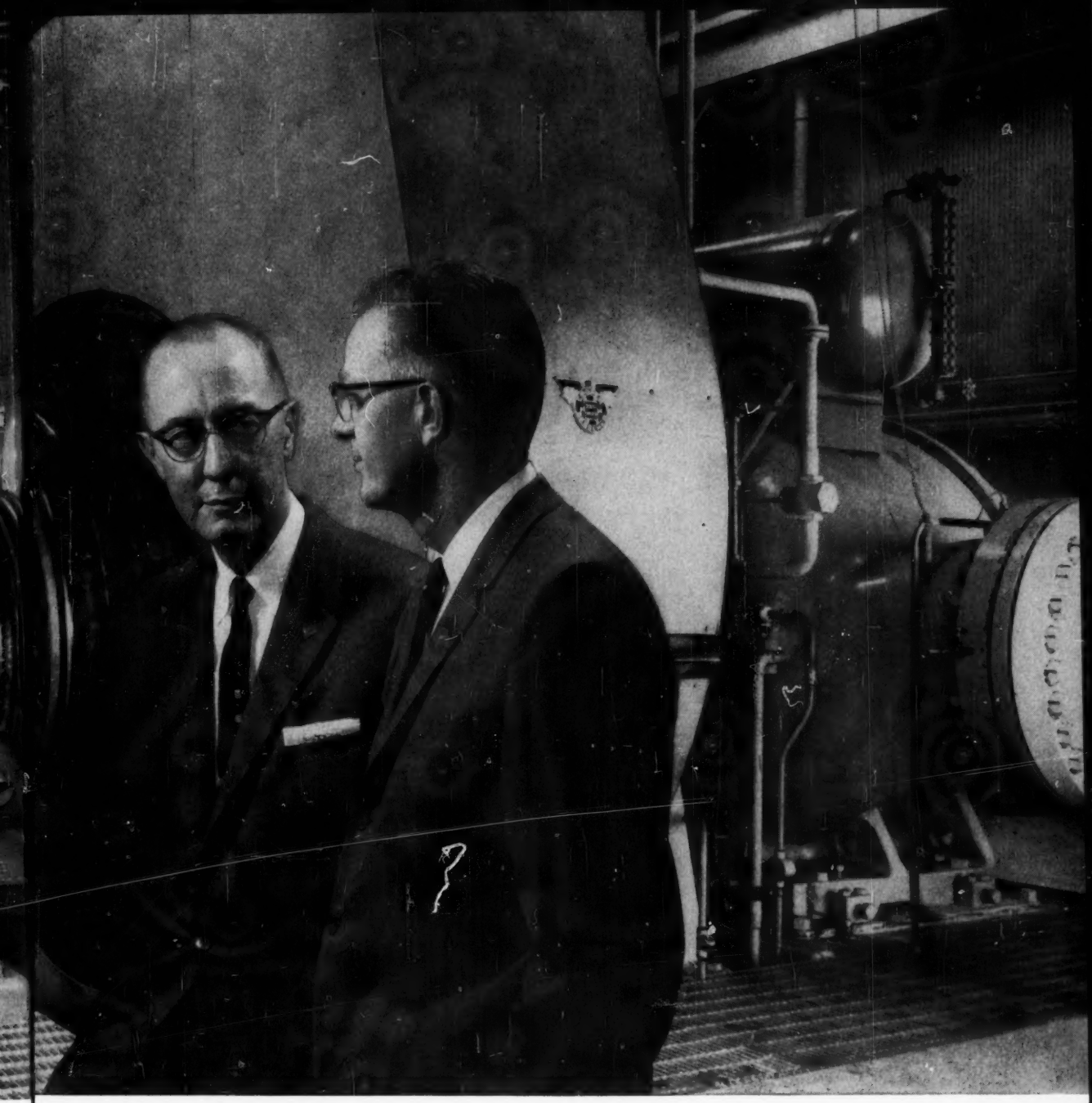

YOU are looking at a revolutionary new concept in industrial power. This Cooper-Bessemer 10,500 hp RT-248 gas turbine with a modified Pratt & Whitney Aircraft J-57 jet engine introduces new, drastic economies in plant construction, operation and maintenance. Shown here on the job at the Clementsville (Kentucky) Compressor Station of Columbia Gulf Transmission Company, this powerful, compact unit has taken on the total gas-boosting load of the station, operating 'round the clock. Find out how this outstanding joint development of Cooper-Bessemer and Pratt & Whitney Aircraft can fit into *your* plans for compressors, generators and other rotating machinery. Call our nearest office.

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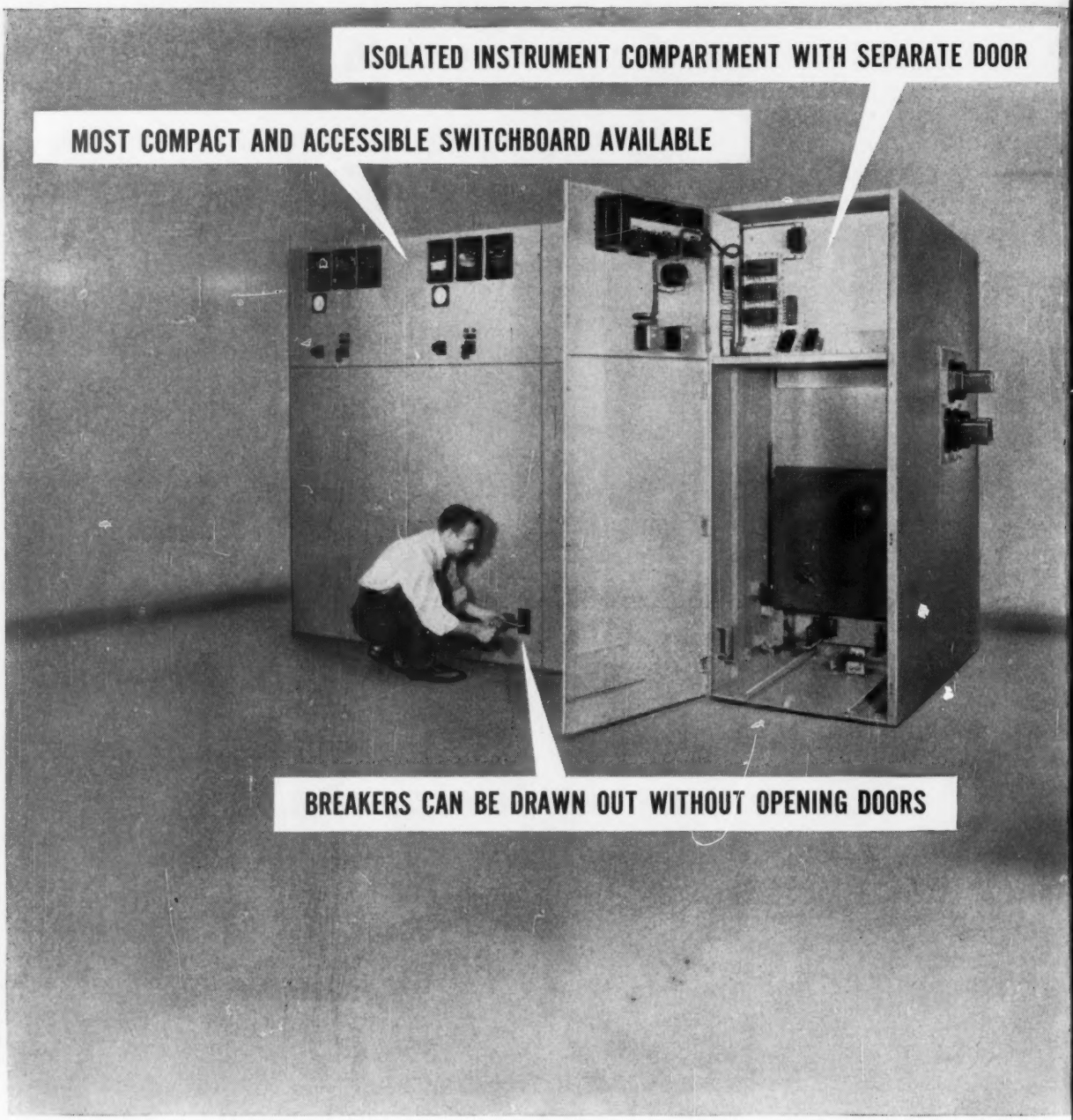
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL, ENGINE, TURBINE OR MOTOR DRIVEN

For more facts circle 219 on Reader Service card, p 99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MOST COMPACT AND ACCESSIBLE SWITCHBOARD AVAILABLE
BREAKERS CAN BE DRAWN OUT WITHOUT OPENING DOORS

NOW YOU CAN ALWAYS,

have fast, safe operation of your

Stored energy closing is just one of the many big progressive steps forward you will find in this all-new I-T-E 13.8 kv switchgear. So is the separate, isolated instrument compartment . . . and the closed door drawout . . . and the more compact switchboard! Here is new safety, new long life potential, and new greater assurance of uninterrupted service.

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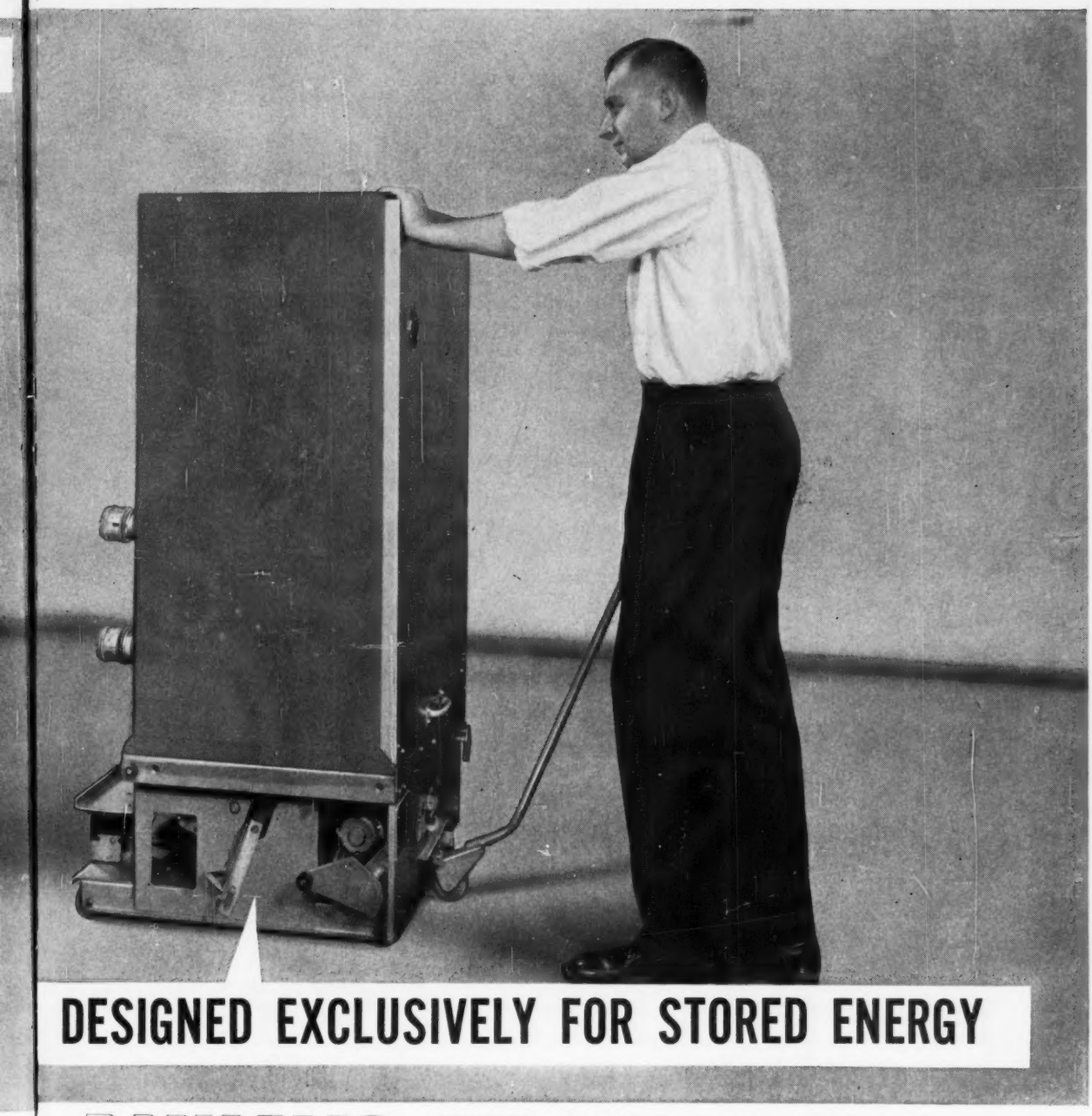

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ALWAYS, IN ALL WAYS

13.8 kv circuit breakers every time

If you are about to specify new 13.8 kv switchgear, make sure you get all these I-T-E advantages. And right now send for illustrated Bulletin 2800-2B, with complete details. Or contact your nearby I-T-E sales office. I-T-E Circuit Breaker Company, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

For more facts circle 220 on Reader Service card, p 99

USED TO THINK EVERY STEAM TRAP LEAKED STEAM.

THEN I FOUND ONE THAT DIDN'T, BUT IT WOULDN'T VENT AIR.

FOUND ONE THAT VENTED AIR, BUT IT NEEDED A COOLING LEG.

DISCOVERED A TRAP THAT REMOVED CONDENSATE AT STEAM TEMP, -MAINTENANCE WAS TOO HIGH.

THEN I FOUND A LOW MAINTENANCE TRAP. IT DIDN'T WORK AGAINST BACK PRESSURE.

AT LAST I FOUND ONE THAT WORKED AGAINST BACK PRESSURE, BUT ITS CAPACITY RATING WASN'T DEPENDABLE.

ARMSTRONG PROMISES TRUE CAPACITIES AND EVERYTHING ELSE, SO I CALLED THEM. THEY TOLD ME TO RELAX. I COULDN'T.

THEY TOLD ME ABOUT ARMSTRONG'S GUARANTEE. WHAT'D I HAVE TO LOSE. I TRIED THEM.

EFFICENCY IS UP, FUEL BILLS ARE DOWN, SO ARE MAINTENANCE COSTS. MAN I'M LIVING!

No one trap can do *everything* better than every other trap. Some traps vent air better than others, some remove condensate faster, etc. But, there is no one trap *best* in every phase of trapping. Armstrong has been manufacturing the Inverted Bucket Trap for nearly fifty years, and though the traps have changed with the requirements of the times, the Inverted Bucket principle has remained. For on overall trap performance, year-in and year-out, nothing beats the Armstrong Inverted Bucket Trap. It's a rugged well-built trap that does *more* things better than any other trap. It's guaranteed because it's been proved.

For more details, see your Armstrong Representative and start living . . .

P. S. Like some good meaty reading? Ask for the 48-page Armstrong Steam Trap Book.

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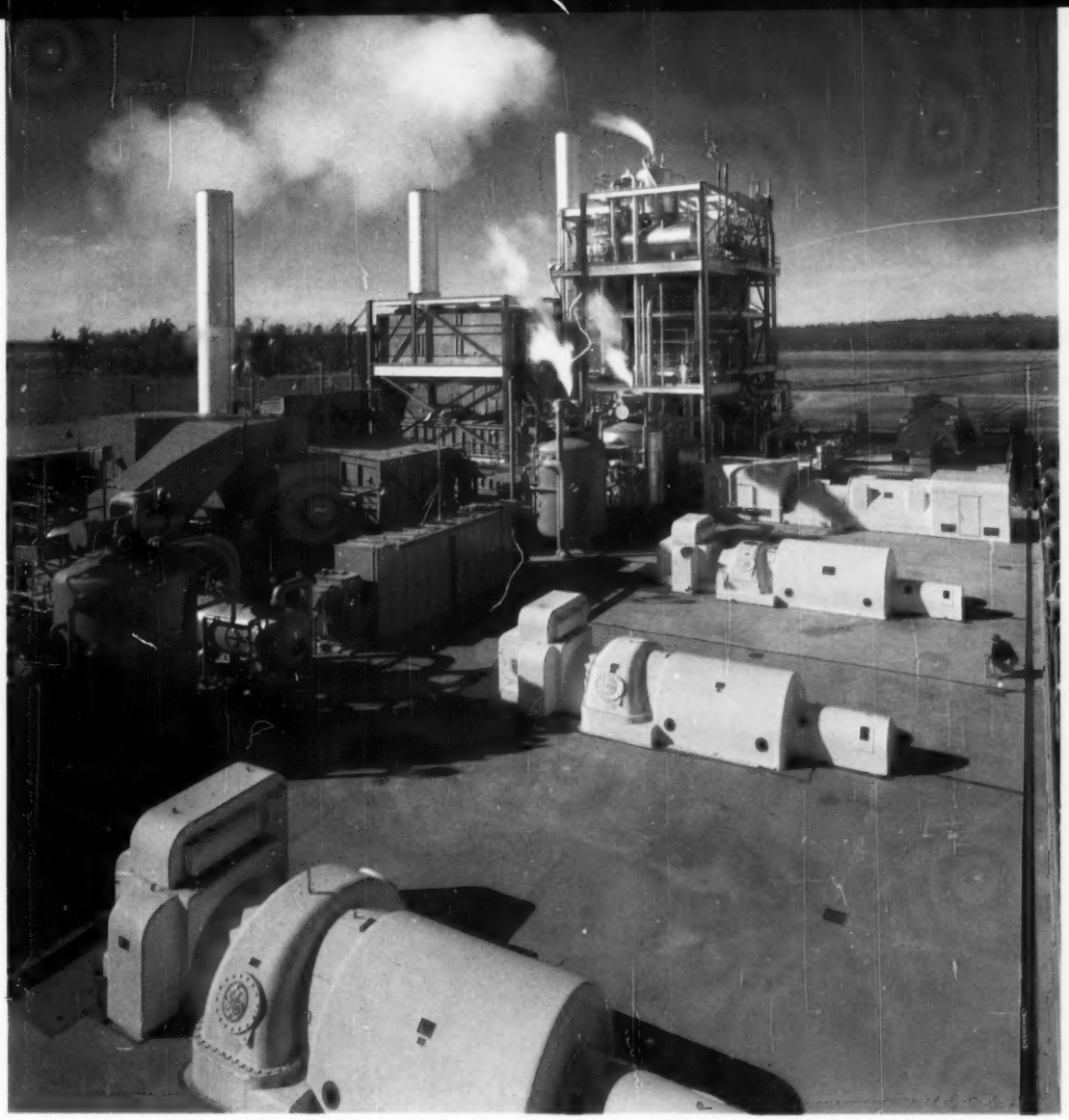

COUGHLIN POWER STATION CENTRAL LOUISIANA ELECTRIC COMPANY, INC. *105,000 kw—5 Units*

Power in Louisiana . . .

Coughlin Power Station is an outstanding example of how major emphasis on plant expansion can anticipate economic growth. The territory served by Central Louisiana Electric Company, Inc., is in a dynamic growth period due to extensive petroleum resources, cotton, sugar, wood products and food processing activities. The company, foreseeing the operating economies of larger generating units, is expanding the capacity of Coughlin well beyond the immediate requirements of the area. Thus, in only ten years the size of units at Coughlin has steadily increased from the original 7,500 kw machines. The newest unit will be rated at 100,000 kw and will go into operation in 1961. This will give the company over 275,000 kw of system capacity with which to serve a territory with a big and bright future.

FULL COLOR BROCHURE outlining the scope of Sargent & Lundy services will be sent on request.

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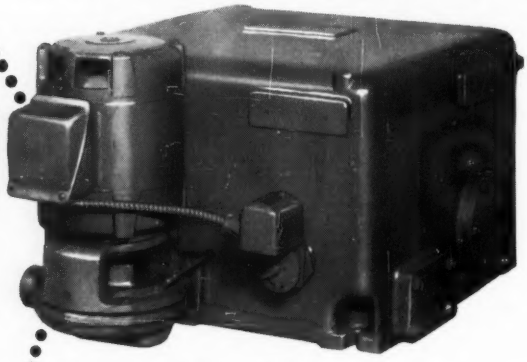

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Capacities through 150,000 sq. ft. E.D.R.

Featuring compact, Centrifugal Pump Design

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Featuring Hoffman Jet Vacuum Producer

Thousands of industrial and commercial steam systems use Hoffman Centrifugal Type Pumps year after year for rapid, low-cost removal of condensate and air from steam lines, and return of condensate to the boiler. Efficient Hoffman Pumps, with all bronze fittings and cast iron receivers, are designed so that all parts subject to wear can be easily inspected, serviced or replaced without disturbing piping. For small systems, Hoffman's line of quality-engineered "Watchman" Condensation Pumps have ratings up to 12,000 sq. ft. E.D.R. Hoffman sales-engineers are available at all times for consultation.

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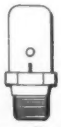
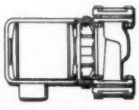


Vacuum Breakers



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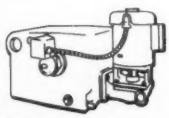
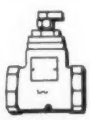
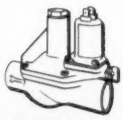


Condensation Pumps

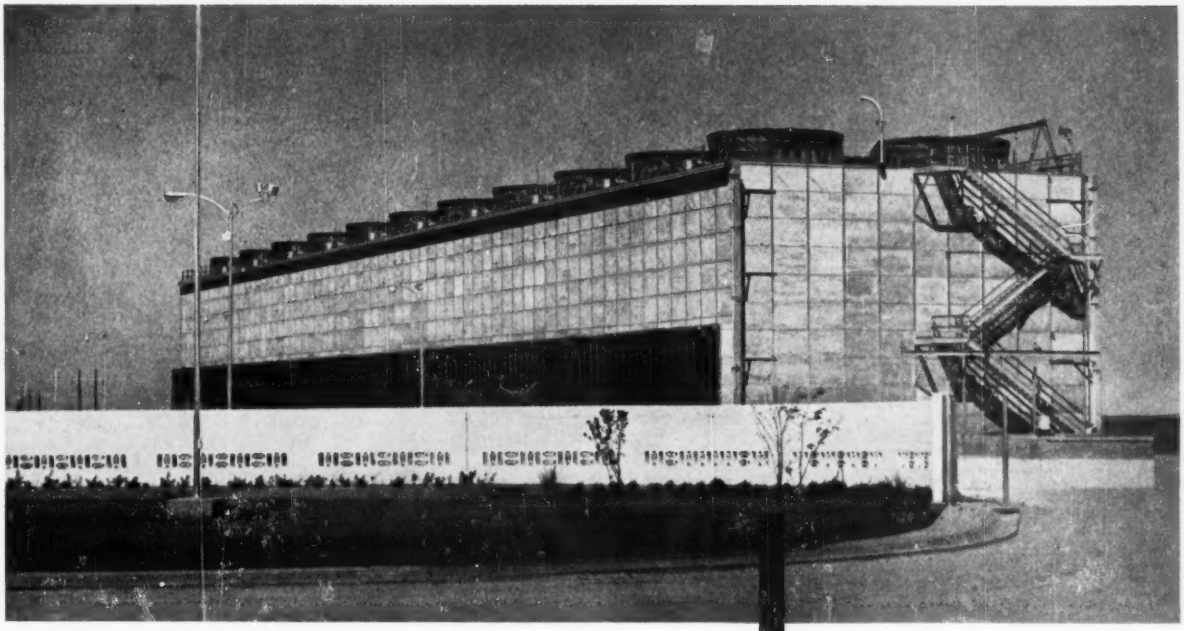


Flow Control Valves



Zonal Valves

FLUOR COOLING TOWERS



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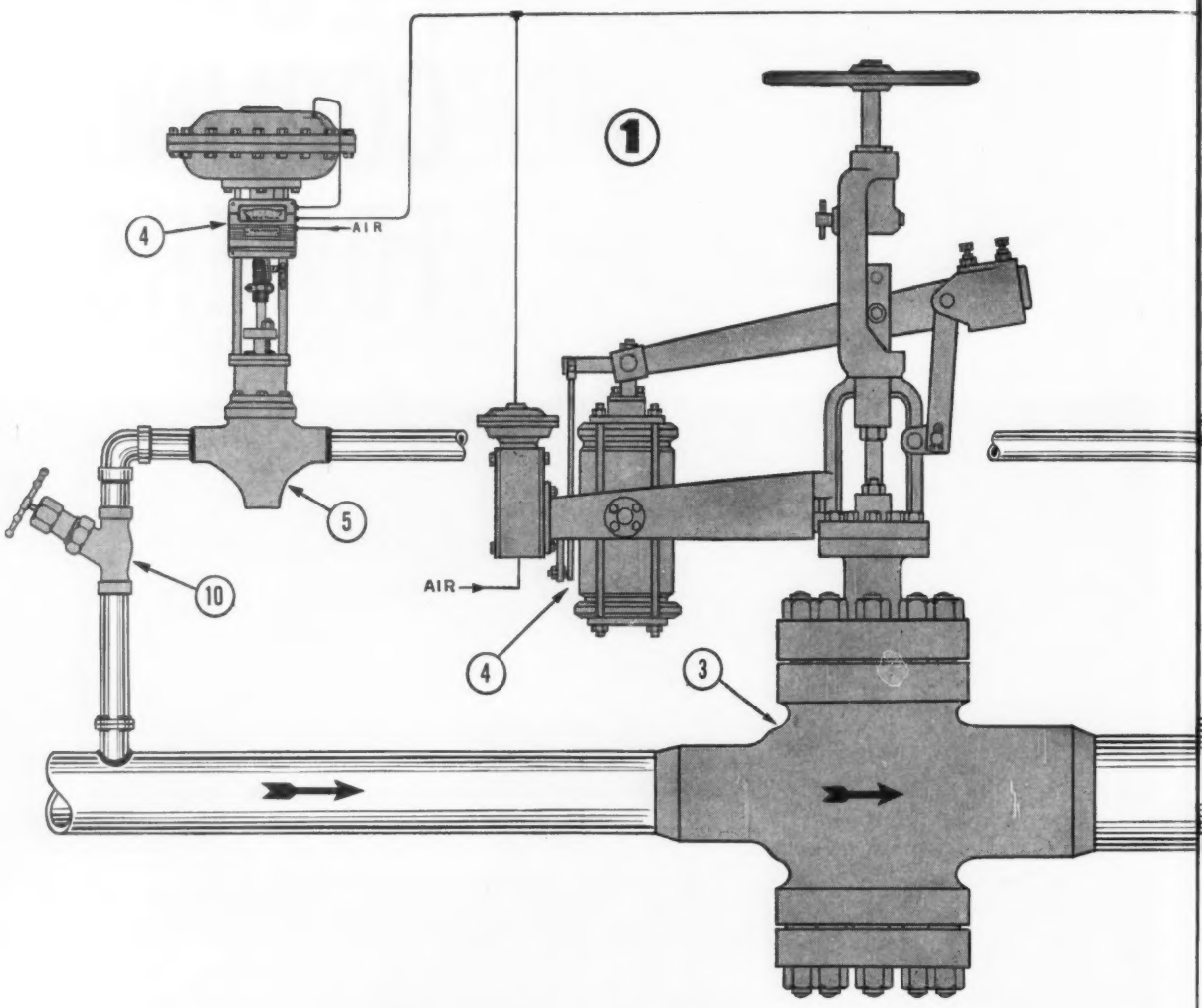
Pressure Reducing and



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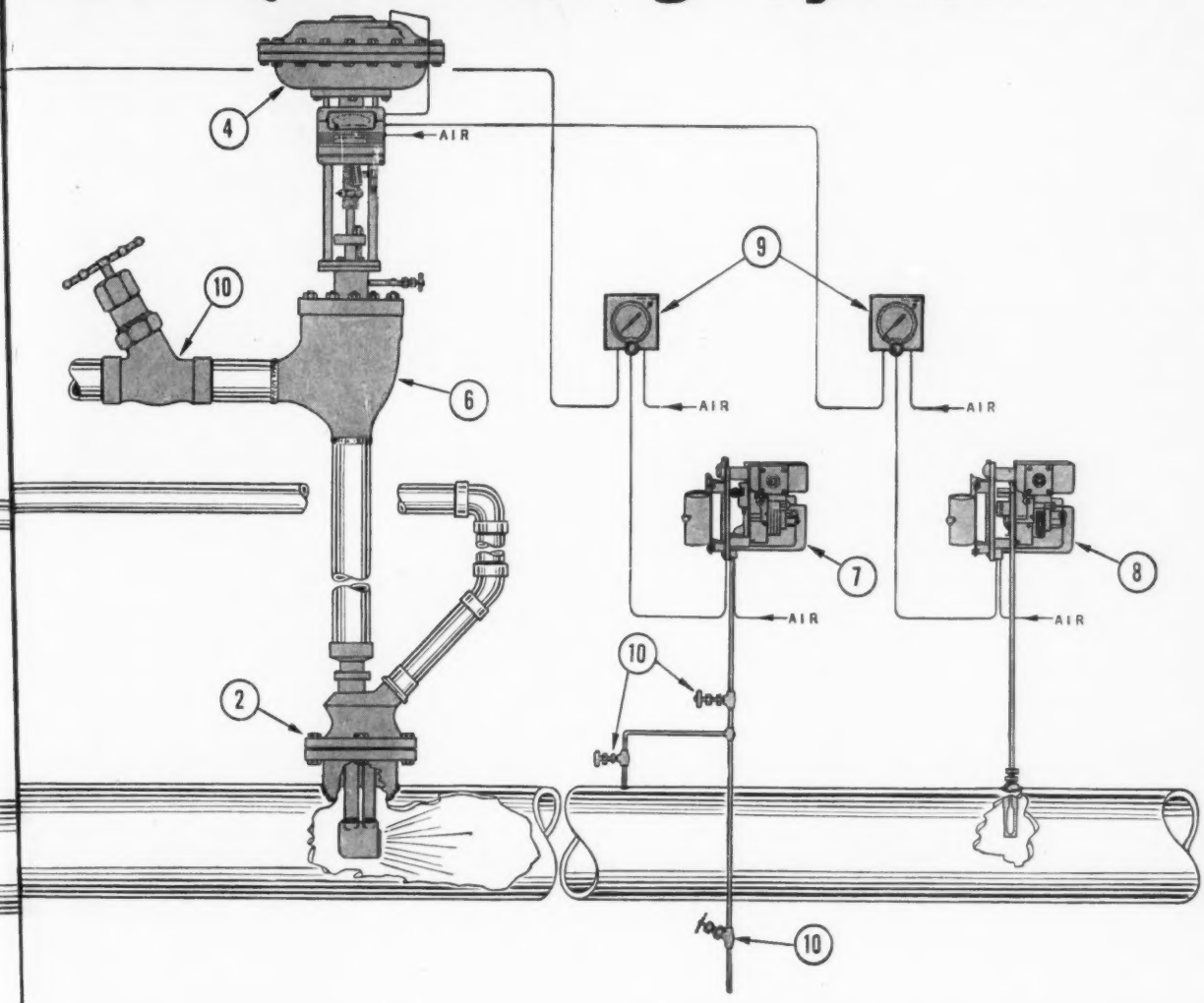

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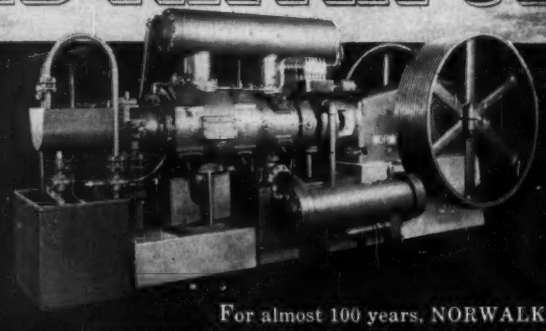

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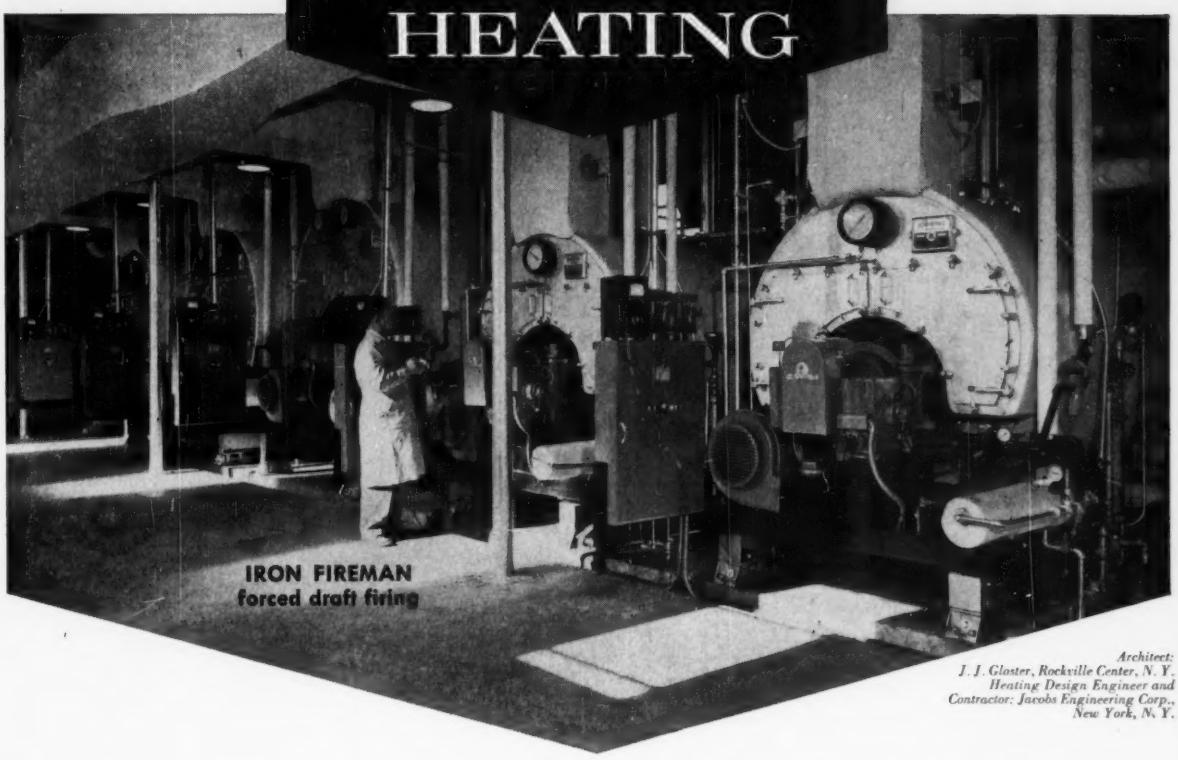

Architect:
J. J. Gloster, Rockville Center, N. Y.
Heating Design Engineer and Contractor: Jacobs Engineering Corp., New York, N. Y.

"Today's package units remove uncertainty"

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A single contract not only keeps your installation costs under control, but greatly reduces these costs as well. It also narrows responsibility for the proper installation and functioning of the equipment.

Easy to size and specify. After determining the required load and deciding on the fuel (gas, oil or dual-fuel combination), it is only necessary to refer to a chart to find the correct size of unit, or units, for your job.

Multiple units have many advantages. You can have a tailor-made plant with low initial cost. A stand-by unit protects you against emergencies or peak loads. You can split your plant between high and low pressure boilers to meet special needs, or between steam and hot water units. Capacities range from 10 to 650 boiler horsepower.

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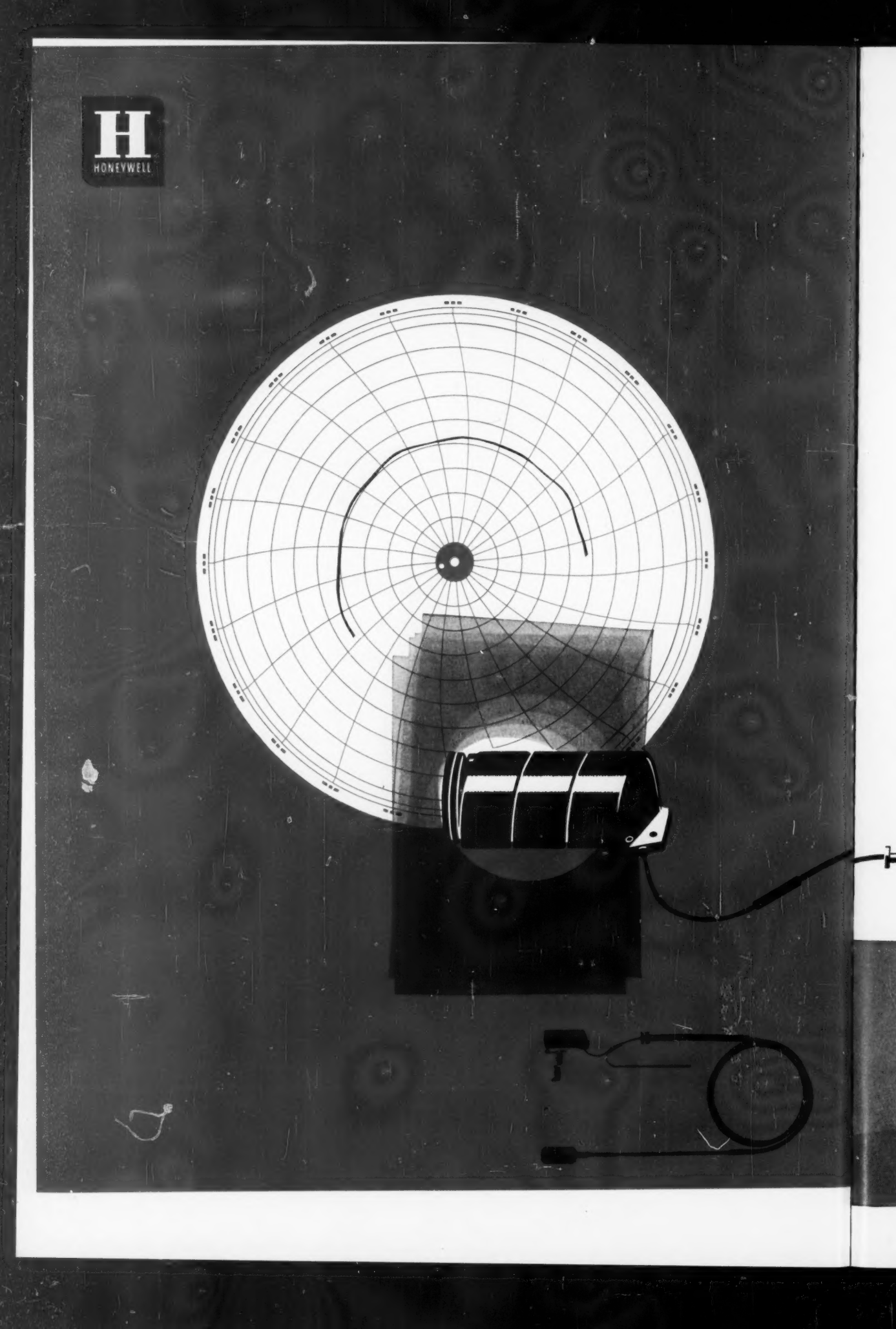
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A complete series of vibration tests has proved the vibration resistance of the new Class III thermal system. In these tests, the Class III system was installed in a standard Honeywell rectangular case recorder, and subjected to forced vibrations in three mutually perpendicular planes. With accelerations up to 0.2G from 0 to 200 cps, maximum pen oscillation was limited to 1.5%. For more than 75% of the range, *pen oscillation was less than 0.5%!* . . . with no resonant effects at 60 cycles.

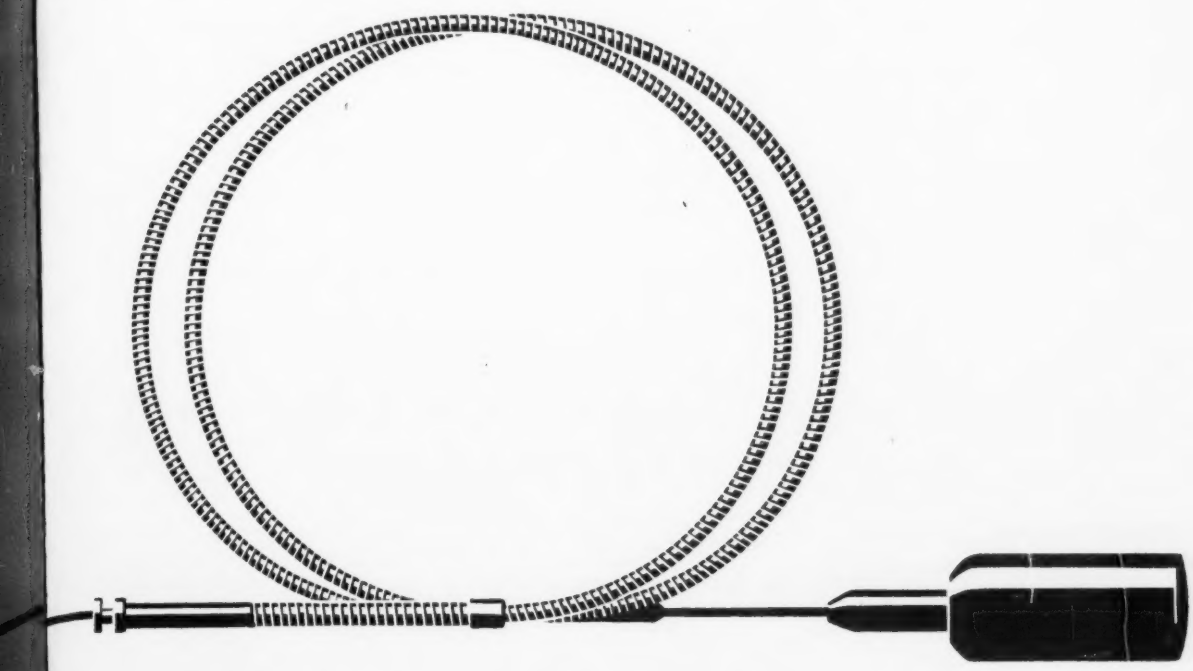
Check these many new design and construction features: high-energy helix for increased sensitivity and lower dead spot; built-in overrange or underrange protection; stainless steel bulbs to withstand corrosive atmospheres; low carbon 316 stainless steel linkages with low-friction, ball-joint construction; coarse and fine zero adjustments for easy settings.

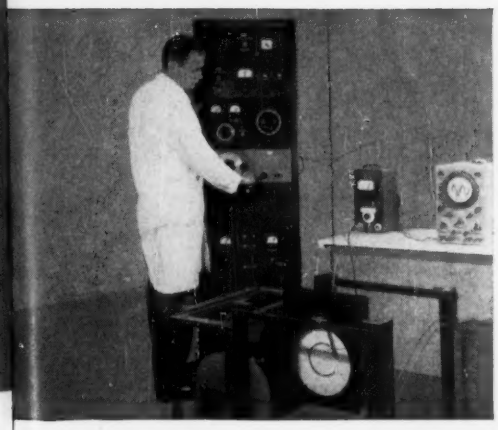
Get the complete story on the new Class III Thermal System by contacting your nearby Honeywell field engineer today. He's as near as your phone. MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pennsylvania.

Honeywell

First in Control

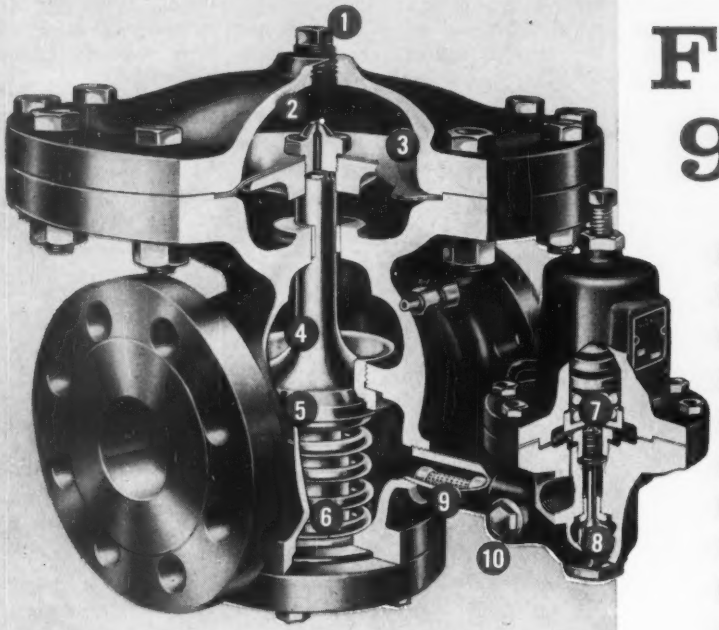
SINCE 1885





For more facts cirlce 227 on Reader Service card, p 99

No Clogged Orifices – No Sticky Valves
No Diaphragm Rupture install the improved



FISHER 92B STEAM REDUCING VALVE

1. Pipe plug directly over bleed orifice for cleaning ease
2. Bleed orifice designed to reduce plugging
3. Stainless steel diaphragms for maximum strength
4. One-piece stainless steel inner valve and stem
5. Stainless steel seat ground at 60° angle
6. Inconel valve spring resists corrosion
7. Bellows seal eliminates pilot valve sticking
8. Pilot valve seat of hardened stainless steel
9. Removable strainer to protect pilot valve seat
10. Pipe plug for easy strainer flushing

Now Available in Tough High Strength Nodular Iron For Pressures Up To 300 psi

Here's a pilot operated, pressure reducing valve designed to minimize problems inherent in steam service. Fisher 92B is a completely self-contained unit. It is especially desirable for use where air or gas is not available as an operating medium.

Once installed the 92B is easily maintained. The bleed orifice can be cleaned by removing one fitting.

PRESSURE RATINGS AND SIZES

Body Material	Working Pressures	End Connections	Body Sizes
IRON	250 psi @ 410°F	Screwed	½"– 2"
	125 psi @ 360°F	125 lb. flgd.	1½"– 6"
	250 psi @ 410°F	250 lb. flgd.	1½"– 6"
NODULAR IRON	300 psi @ 450°F	Screwed	½"– 2"
	150 psi @ 366°F	150 lb. flgd.	1½"– 3"
	300 psi @ 450°F	300 lb. flgd.	1½"– 3"

The inner valve, seat ring and main spring can all be reached through the blind flange. The 92B reduces inlet pressures up to 300 psi down to outlet pressures from 2 to 150 psi. Precision construction of the pilot gives the valve exceptionally close accuracy.

NODULAR IRON CONSTRUCTION

The 92B is now available in Type 60-45-15 Nodular (ductile) iron (ASTM No. A395-56T). This extremely tough, high strength iron can be cast into the intricate shapes of the 92B and still retain full strength and pressure tightness. In addition Nodular iron resists corrosion, extreme heat and thermal shock. Precision machining plus rugged Nodular iron construction adds up to this notably improved version of the time-tested 92B.

WRITE TODAY FOR FULL DETAILS
ASK FOR BULLETIN D-92B

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD...CHANCES ARE IT'S CONTROLLED BY...

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT COMPANY, CORAOPOLIS, PA.

FISHER® Controls

SINCE 1880

For more facts circle 228 on Reader Service card, p 99

Easily-installed PPG Neoprene-coated Duct Liner now meets fire requirements, provides extra margin of safety on ductwork installations.

NOW—PPG Fiber Glass Duct Liner Carries the UL Label

PPG Neoprene-Coated Superfine Duct Liner Meets All Requirements of NBFU Bulletins No. 90-A and 90-B for Ducts

YOUR ASSURANCE OF SAFETY

PPG is proud to announce that its Neoprene-coated Superfine Fiber Glass Duct Liner has been thoroughly tested according to the condition determined by National Board of Fire Underwriters, and has met the Board's rigid safety requirements in compliance with Bulletins No. 90-A and 90-B for ducts. It now bears the label of the Underwriter's Laboratories, Inc.

For you, this means that PPG Neoprene-coated Fiber Glass Duct Liner meets fire requirements and provides that extra margin of safety on any ductwork installation.

PLUS ALL THOSE EXTRA PPG ADVANTAGES...

. . . such as lightweight, easy handling, easy cutting and piecing, low wastage, fast installation, fine acoustical qualities, good thermal barrier characteristics, low resistance to air flow, no air erosion; and lifetime service, because it won't rot or decay, is not affected by humidity or dryness.

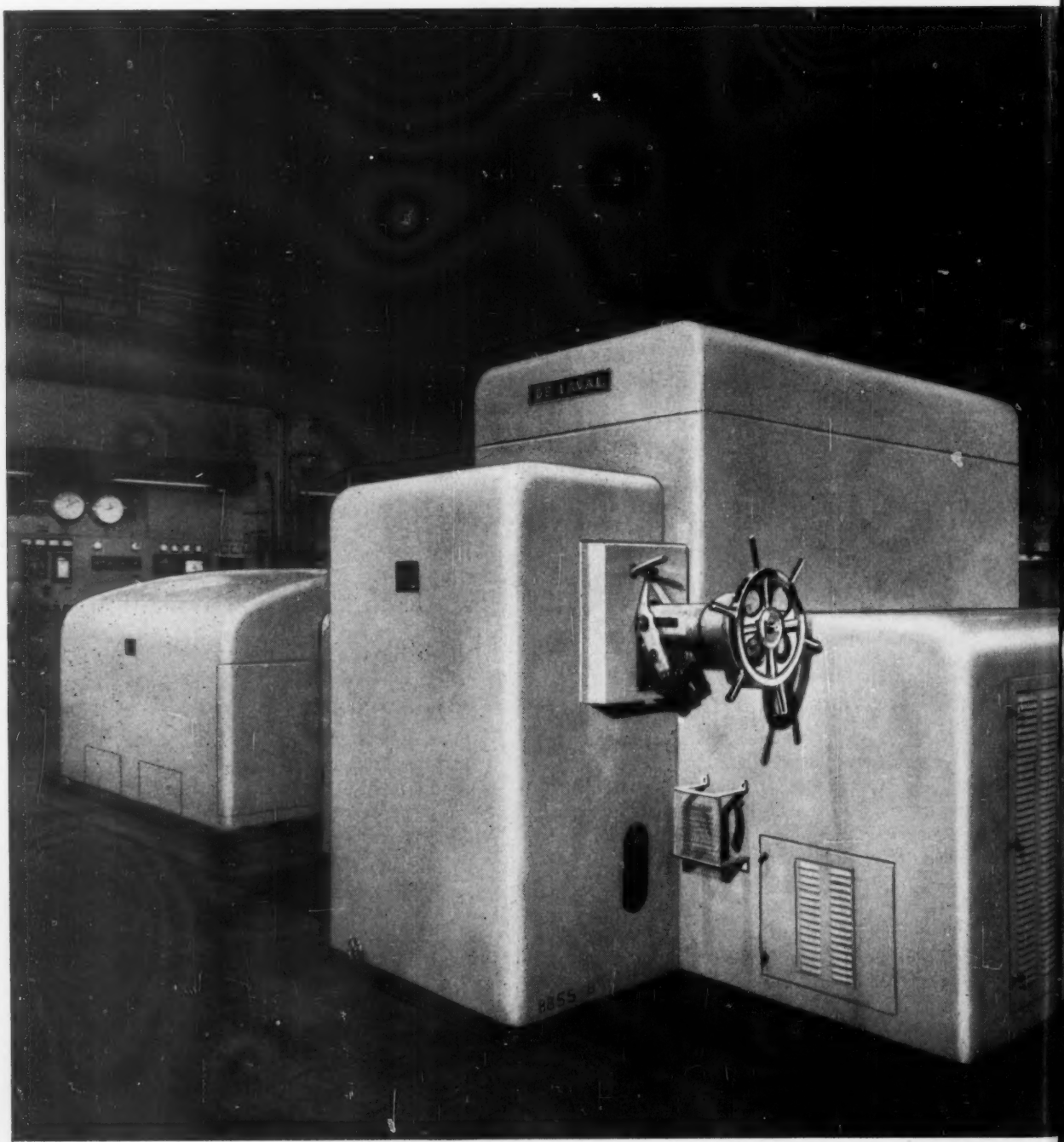
Give PPG Fiber Glass Duct Liner a try. It offers you a combination of top-flight insulation and economy. For full information, call your nearest PPG Fiber Glass Sales Office, or write *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.*

Sales Offices: Atlanta, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Fort Wayne, Houston, Jacksonville, Kansas City, Los Angeles, Louisville, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Seattle and Washington.

FIBER PPG GLASS PITTSBURGH PLATE GLASS COMPANY

For more facts circle 229 on Reader Service card, p 99

DE LAVAL provides power and process steam

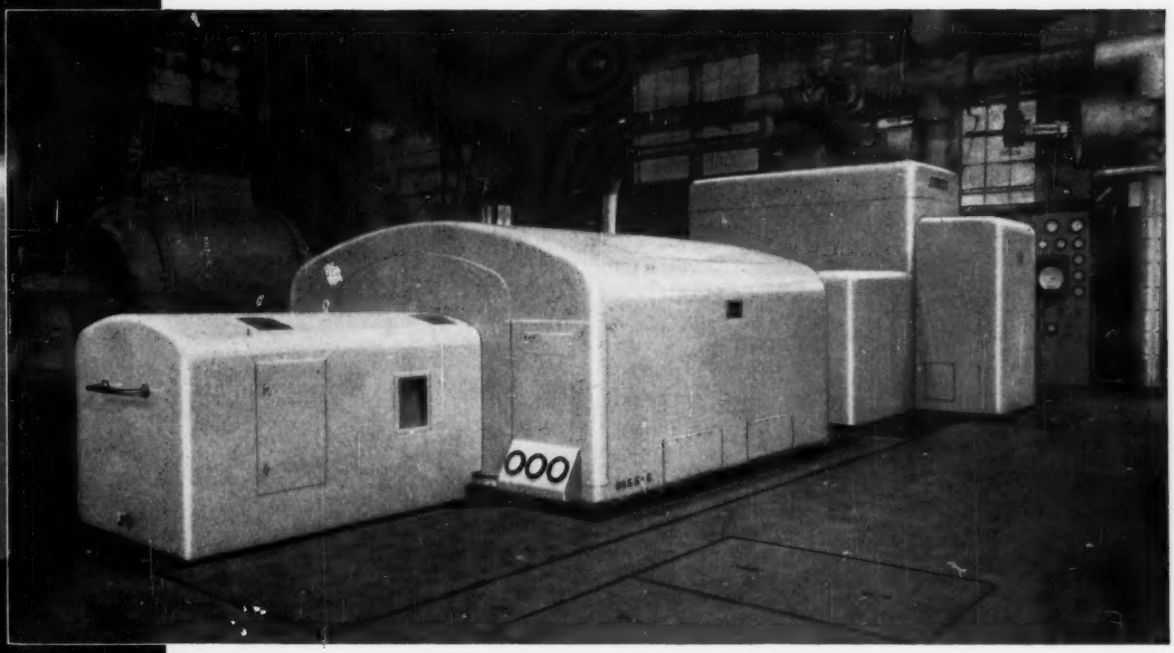


economical
for Corn Products Company

Sargent & Lundy, Consulting Engineers, handle project for new 9375 KW unit.

De Laval design engineers are specialists in meeting unusual requirements. For example, this unit at the Corn Products plant in Pekin, Illinois, is presently operating with 400 psig ISP at 580 F, with 6 stages to develop 5000 KW at a back pressure of 165 psig. Flexible De Laval design will enable this turbine to operate under new steam conditions with 11 stages for which space has been provided in the casing. When operating at its future steam conditions of 850 psig ISP, 700 F, the turbine will develop 9375 KW and will provide 275,000 pounds of steam per hour to the process at a pressure of 165 psig.

De Laval application engineers will gladly give you more information on steam turbines to suit your specific needs.



DE LAVAL STEAM TURBINE COMPANY

815 NOTTINGHAM WAY, TRENTON 2, NEW JERSEY

DL203

POWELL HIGH PRESSURE VALVES

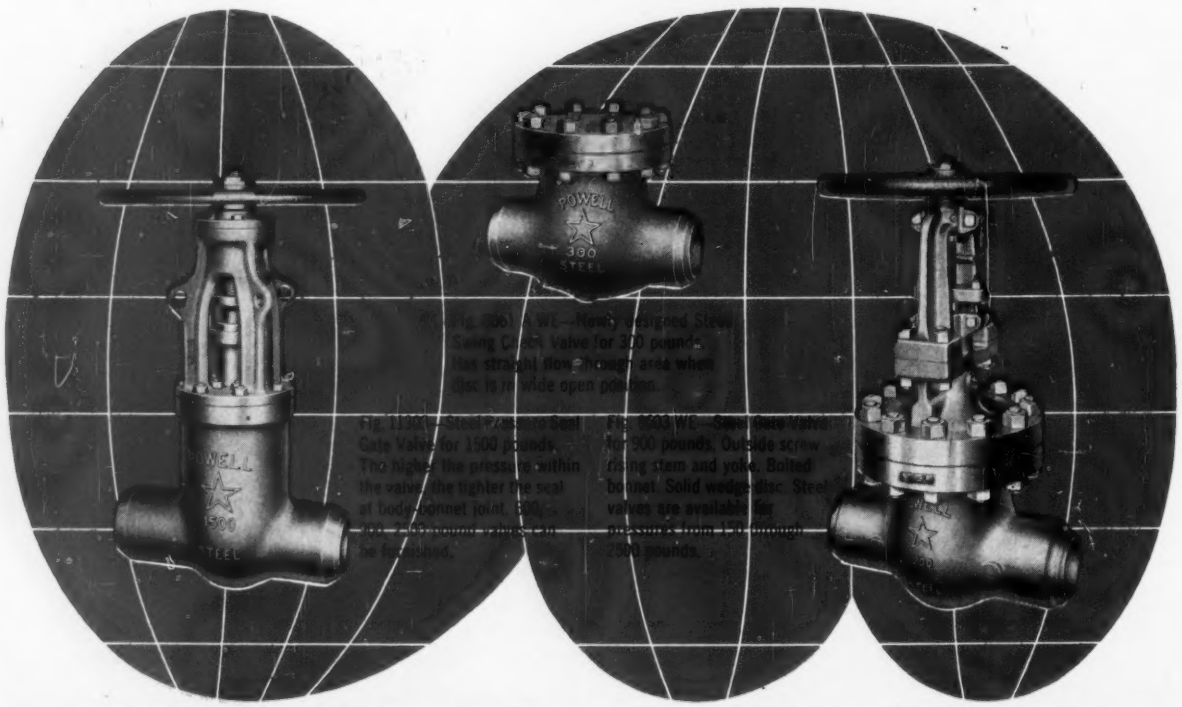
performance that makes a world of difference

Gate, Non-Return, Globe, Angle "Y", and Check Patterns—All Commercial Sizes—for—150 to 2500 Pounds and Higher; Temperatures—sub zero to 1200 F.

To handle the increasingly higher pressures and temperatures required by modern industry, Powell offers the highest quality steel valves with many exclusive Powell features of superior design and construction.

Many of these Powell Valves are stocked for quick delivery. Contact your city's Powell Valve distributor. Or write directly to us. Our engineers will quickly solve your flow control problems encountered in handling water, oil, gas, air, steam, corrosive fluids.

Powell . . . world's largest family of valves



THE WM. POWELL COMPANY • DEPENDABLE VALVES SINCE 1846 • CINCINNATI 22, OHIO

LOUIS N ROWLEY, EDITOR • JANUARY 1961 • ESTABLISHED 1882 **Power**

Do you know UBPVLS?

The chances are you don't know the organization for which those initials stand—but you should. Everyone involved in the design or use of boilers and pressure vessels benefits from the work of the Uniform Boiler and Pressure Vessel Laws Society and can contribute—in one way or another—to its activities.

To understand the need filled by UBPVLS, look back to the early years of this century. Accidents involving boilers were then so common that POWER carried a regular report under the heading "Boiler explosions this month." And its editorial columns urged action to codify boiler construction practices and license the men who operated them.

Beginning about 1908, a few states and cities enacted laws and ordinances dealing with boiler construction. Instead of progress, these produced costly confusion because they varied greatly. A vessel meeting the requirements of one state often could not meet the laws of another. Inspectors qualified in one state had no standing anywhere else. Such were the variations in safety factors, materials and design practices that public confidence in boiler safety sank even further, while demand for uniformity rose.

As an independent national organization competent to deal with the technical problems of boiler safety, the American Society of Mechanical Engineers took, in 1911, the public-spirited step of setting up a committee to formulate standards for construction of boilers and pressure vessels. And in 1914, the first ASME Boiler Code was issued.

But this was only half the battle. Unless legally adopted, the ASME Code lacked the full force and effect of law. It was to foster the adoption of uniform ASME-based state laws and municipal ordinances that UBPVLS was formed in 1916, under the name American Uniform Boiler Law Society. What has this nonpolitical, nonprofit, noncommercial association accomplished since then?

In 1916, the ASME Code had not been legally adopted anywhere. Today, 37 of our states, the District of Columbia, Panama Canal Zone, Puerto Rico and all the provinces of Canada except Prince Edward Island have adopted one or more sections of the Code. But much remains to be done: There are still 13 states with no ASME-based boiler and pressure-vessel laws, and constant activity is needed to strengthen existing laws and fight attempts to weaken or dilute them.

This is the task to which UBPVLS is dedicated, a task in which all concerned with boiler safety should play a part. How? First, by encouraging membership and active participation by your own company. Owners and users of boilers and pressure vessels are now numbered among the members, along with equipment manufacturers and insurers, but an increase in such user representation would be welcome. Second, you can help by putting your weight, and your company's, on the side of constructive legislative action in this field.

As a member of UBPVLS, your company will be kept informed of new and amended laws and regulations. UBPVLS advises and assists members who have problems involving boiler laws and rules. It also issues data on boiler-operator licensing, etc.

Support of the work of the Uniform Boiler and Pressure Vessel Laws Society is an acknowledgment of the incalculable benefits industry receives from its work and, more important, it is an investment in continued progress in the development of safe, economical boilers and pressure vessels.

JENKINS PRACTICAL PIPING LAYOUT 84

How to plan piping connections for a

SNOW MELTING SYSTEM

For controlled melting of snow and ice on exterior surfaces, use of a warm fluid circulating in pipe coils buried in paving material is rapidly expanding. Piping may be steel, wrought iron, brass or copper depending on conditions. Today one may see snow melting systems in many different locations including walks, driveways, ramps, parking areas, street intersections, bridges, hangar door tracks, loading docks, storage yards.

Conditions encountered in the specific installation should dictate details of construction, so the layout shown here cannot represent necessarily correct installation practice for every job. Some of the factors to be considered are severity of snowstorms, prevailing temperature, speed of removal desired, heat sources available, heat losses, hydraulic requirements.

Hydraulic requirements are determined by the amount, size and arrangement (sinuous or grid coils)of the pipe as they determine size of circulator or pump. Regardless of type of pipe circuit used, the friction loss should be kept as nearly equal as possible between all circuits, and when necessary to obtain approximately the same pressure drop to each circuit, valves or balancing cocks are recommended.

The heat required varies with conditions but an output of 100 to 200 BTU per hr. per sq. ft. of surface has been adequate for most installations. In addition to heat output at surface, there should be an allowance of 30 to 50 per cent for back and edge losses, this being related to amount of insulation and cycle of operation as well as to fuel costs.

Air pockets or collections in the pipe system should be avoided, and where grading conditions require different parts of the pipe system to be pitched in different directions, it may be necessary to provide air vent lines from high points of pipe loops and carry the vent lines to air vent valves in a curb box.

Drains are generally provided at low points for draining coils if required although annual drainage is not necessary.

As a snow melting system is fundamentally a forced circulation hot-water system, most standard practices for a hot-water system may be followed in the boiler or heat exchanger hook-up.

The system shown here uses steam heated hot water at 212°F., to which is added conventional ethylene glycol anti-freeze and a rust inhibitor.

The expansion or surge tank should be of generous size because of the greater expansion properties of water containing anti-freeze. The tank not only serves to liberate air and provide for expansion but also allows for initial filling and subsequent addition of water and anti-freeze. Its provisions should meet all code requirements including a guarantee against contamination of city water supply by a treated liquid.

Jenkins Fig. 106-A screwed end bronze globe valve, (or its equivalent Fig. 1270 with socket ends, or Fig. 1270 with solder ends), is used extensively throughout this piping layout. Its renewable disc assures drop-tight closure, and it incorporates many other design and construction features which mean economical maintenance and long, trouble-free life. Valves should be packed with solvent resistant packing. Disc type valves should be fitted with Teflon discs.

To assure efficiency in the job when planning any major piping installation, consult with accredited piping engineers and contractors.

To make certain of trouble-free, economical valve performance, select your valves from the Jenkins Catalog. It shows types and patterns, made of different metals for an endless variety of needs.

For prompt, capable help when you want Jenkins Valves and other supplies for your job, call the top-flight distributor who represents Jenkins in your city.

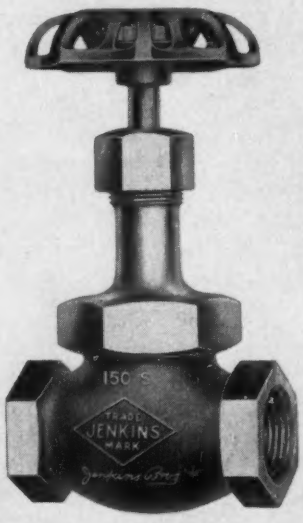


Fig. 106-A BRONZE GLOBE VALVE Renewable Composition Disc
150 lbs. Steam 300 lbs. O.W.G.

JENKINS BROS., 100 Park Avenue, New York 17

Send descriptive folder 189-A on
Fig. 106-A Bronze Globe Valves.

Name.....

Company.....

Address.....

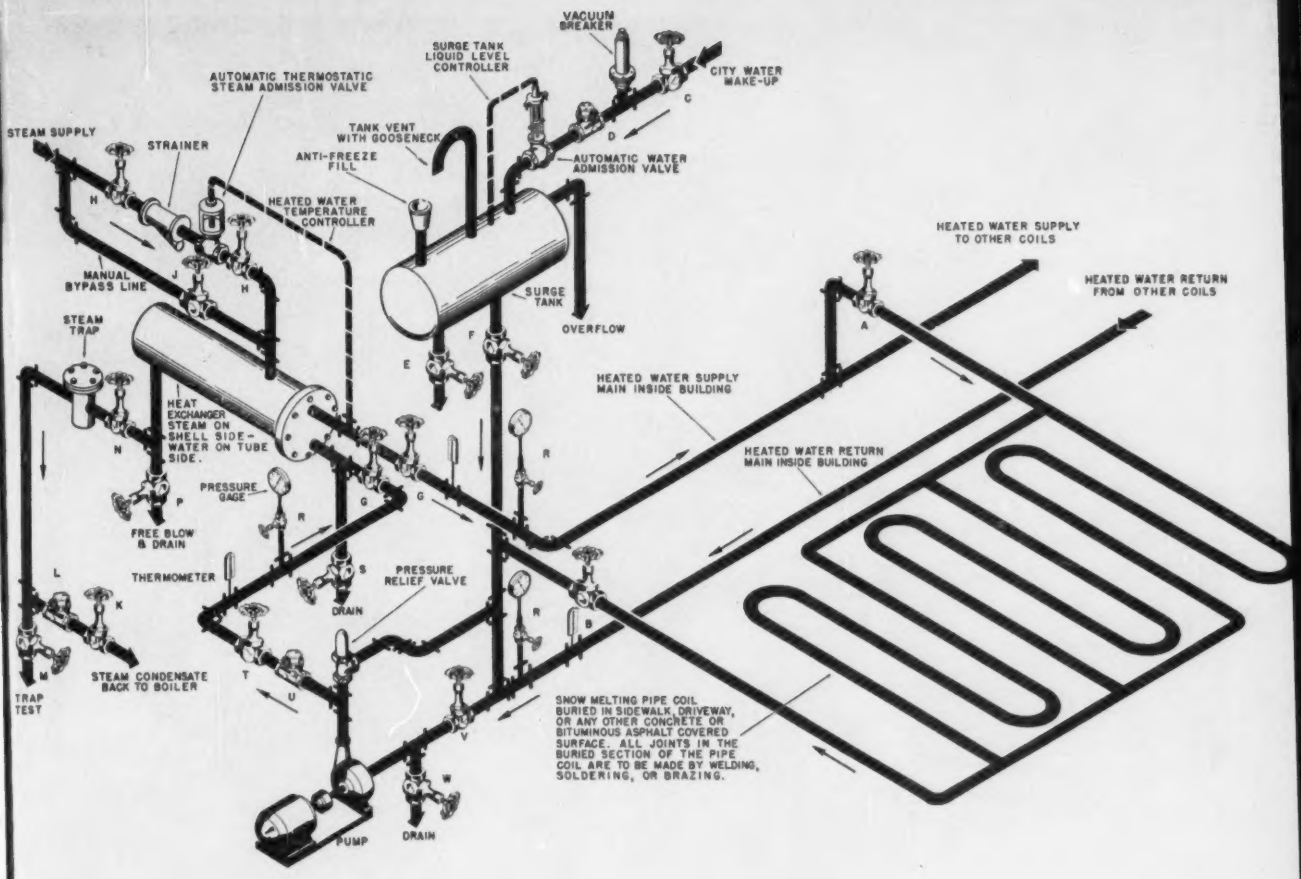

VACUUM BREAKER
SURGE TANK LIQUID LEVEL CONTROLLER
CITY WATER MAKE-UP
AUTOMATIC THERMOSTATIC STEAM ADMISSION VALVE
STEAM SUPPLY
STRAINER
TANK VENT WITH GOOSENECK
ANTI-FREEZE FILL
AUTOMATIC WATER ADMISSION VALVE
HEATED WATER TEMPERATURE CONTROLLER
HEATED WATER SUPPLY TO OTHER COILS
HEATED WATER RETURN FROM OTHER COILS
MANUAL BYPASS LINE
SURGE TANK
OVERFLOW
STEAM TRAP
HEAT EXCHANGER STEAM ON SHELL SIDE—WATER ON TUBE SIDE.
HEATED WATER SUPPLY MAIN INSIDE BUILDING
HEATED WATER RETURN MAIN INSIDE BUILDING
PRESSURE GAGE
FREE BLOW & DRAIN
THERMOMETER
DRAIN
PRESSURE RELIEF VALVE
STEAM CONDENSATE BACK TO BOILER
TRAP TEST
SNOW MELTING PIPE COIL BURIED IN SIDEWALK, DRIVEWAY, OR ANY OTHER CONCRETE OR BITUMINOUS ASPHALT COVERED SURFACE. ALL JOINTS IN THE BURIED SECTION OF THE PIPE COIL ARE TO BE MADE BY WELDING, SOLDERING, OR BRAZING.
PUMP
DRAIN

Diagram by Huxley Madeheim
Consulting Engineer
Copyright 1960 — Jenkins Bros.

CODE	QUAN.	JENKINS VALVE	SERVICE
A	1 per coil	Fig. 47-U, Bronze Gate	Coil Shutoff
B	1 per coil	Fig. 106-A, Bronze Globe	Regulate Flow Thru Coil
C	1	Fig. 106-A, Bronze Globe	Regulate and Shutoff City Water
D	1	Fig. 92-A, Bronze Swing Check	Prevent Backflow Into City Water Lines
E	1	Fig. 106-A, Bronze Globe	Surge Tank Drain
F	1	Fig. 106-A, Bronze Globe	Surge Tank and Balance System Control
G	2	Fig. 47-U, Bronze Gate	Tube Side of Heat Exchanger Shutoff
H	2	Fig. 47-U, Bronze Gate	Automatic Valve Shutoff
J	1	Fig. 106-A, Bronze Globe	Manual Bypass Control
K	1	Fig. 47-U, Bronze Gate	Shutoff System From Steam Condensate
L	1	Fig. 92-A, Bronze Swing Check	Prevent Steam Condensate Backflow
M	1	Fig. 106-A, Bronze Globe	Trap Test Control
N	1	Fig. 47-U, Bronze Gate	Steam Trap Shutoff
P	1	Fig. 106-A, Bronze Globe	Free Blow and Drain Shell Side of Heat Exchanger Control
R	3	Fig. 743-G, Bronze Needle	Pressure Gage Control
S	1	Fig. 106-A, Bronze Globe	Tube Side of Heat Exchanger Drain
T	1	Fig. 106-A, Bronze Globe	Regulate Pump Discharge and Shutoff Pump
U	1	Fig. 92-A, Bronze Swing Check	Prevent Backflow Into Pump
V	1	Fig. 47-U, Bronze Gate	Pump Shutoff
W	1	Fig. 106-A, Bronze Globe	Pump Drain

VALVE RECOMMENDATIONS

For details of valves to suit varying conditions see Jenkins Catalog

JENKINS

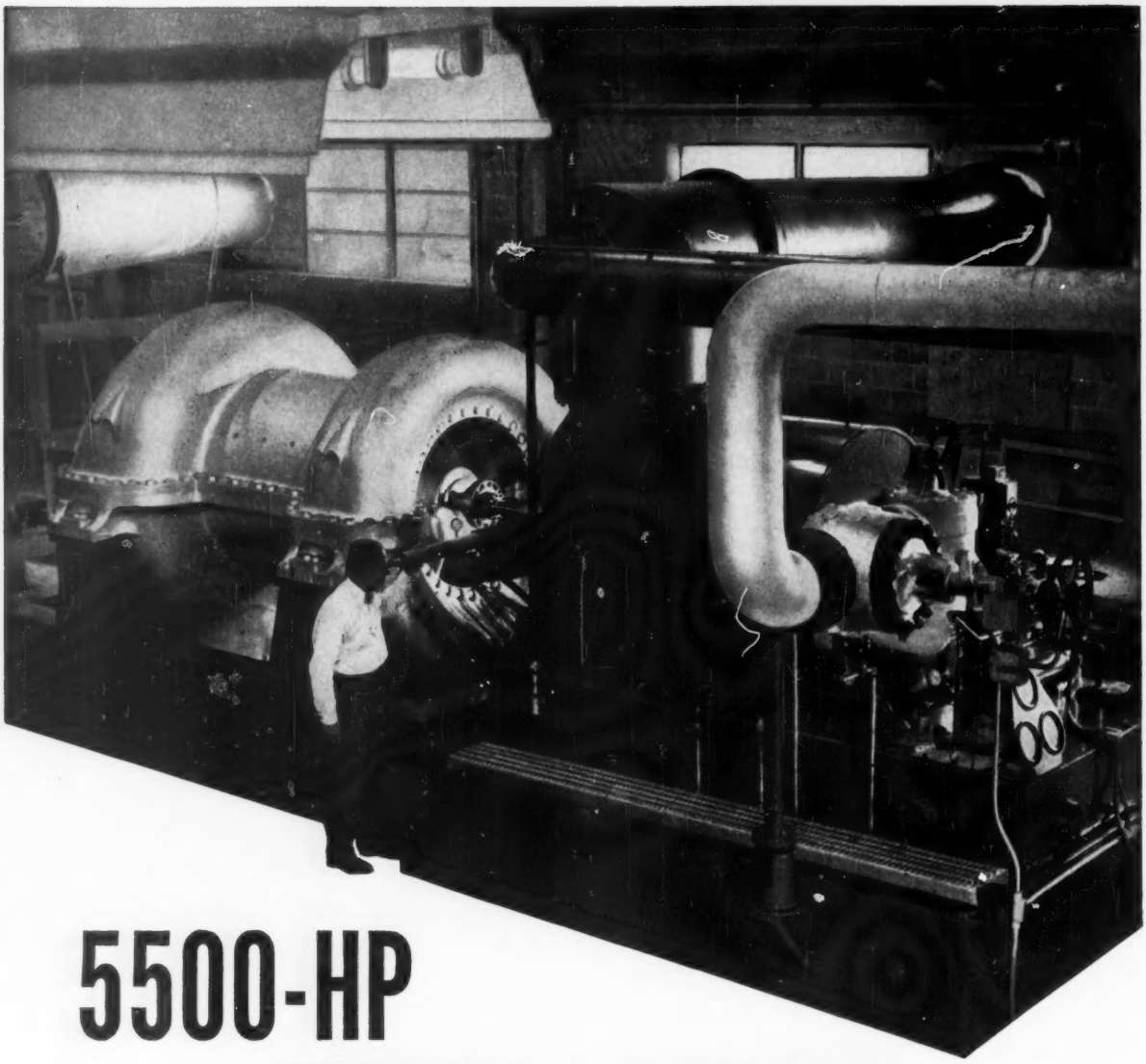
LOOK FOR THE JENKINS DIAMOND

VALVES

JENKINS SINCE 1864 Jenkins Bros

Sold Through Leading Distributors Everywhere

For more facts circle 232 on Reader Service card, p 99



5500-HP TERRY TURBINE

plays an important role in compressor testing at Joy

Joy Manufacturing Company puts Terry high-speed turbine reliability to good use in its development facility at Buffalo, New York. This 5500-hp multistage turbine is used for testing centrifugal and axial-flow compressors. It provides speeds up to 9,000 rpm.

The long, trouble-free life of Terry high-speed turbines stems from two sources: (1) more than 50 years of successful experience in making turbine drives *exclusively*, (2) a willingness to build *something extra* into each machine to assure its reliability.

There's a reliable Terry turbine for you in sizes up to 6000 hp. In special cases higher outputs can be supplied.

For more information about Terry multistage turbines, ask for a copy of bulletin S-146.

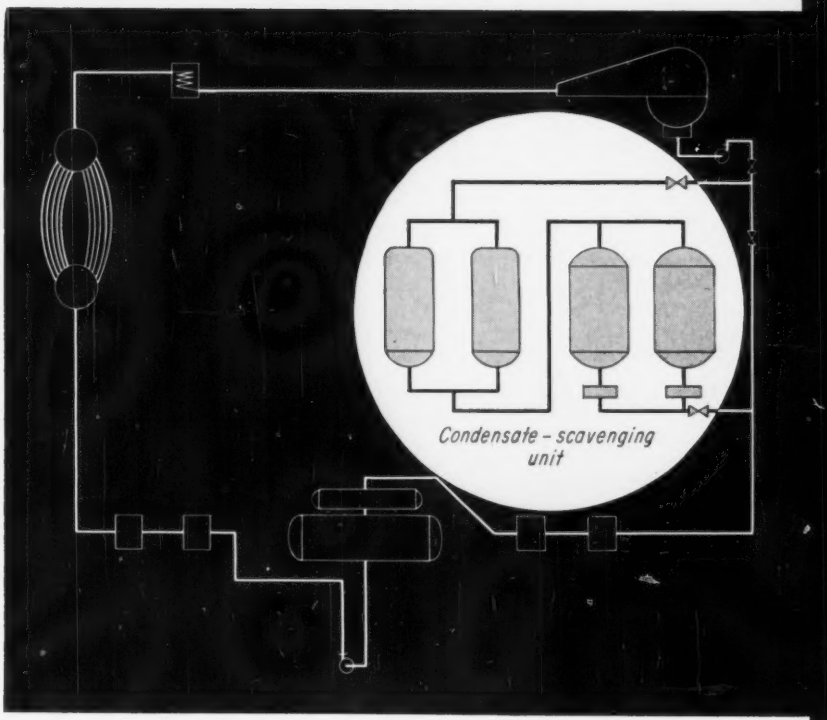
TERRY

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TT-1215

B G A SKROTZKI
Associate Editor in Charge

a Today's Development report



CONTINUOUS SCAVENGING with no-solids treatment gives maximum cycle protection

Absence of blowdown in supercritical and some subcritical steam generators has led to "kidney" treatment of condensate. Now this appears to be spreading to some high-pressure drum type boiler units. But where is the end point? Here's an up-to-date report on . . .

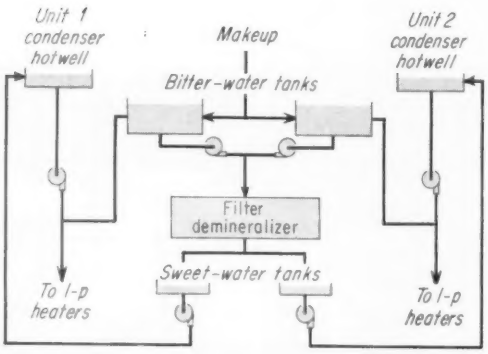
High-rate condensate scavenging

By T W EDWARDS, Assistant Editor

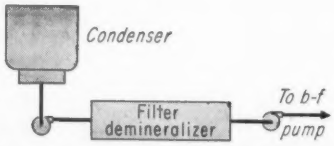
Principles and hardware used in modern condensate-scavenging units are not new; filtration and ion exchange have been around a long time. But their necessary extension in size and flow rates to meet bypass and full-flow condensate-treatment capacities does present new problems. Goals of condensate scavenging are pretty well defined; the "how-to" is controversial.

Optimum results mean balancing cost and need; perfect condensate purity —attainable at a price—is not best if need for it doesn't justify cost. So there is no pat answer to condensate scavenging. Each installation must be designed on the basis of just what purity it needs. continued

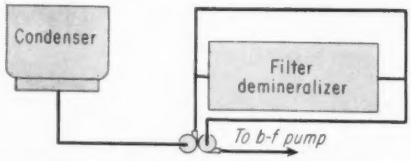
Today's units run gamut of design and equipment combinations



PHILADELPHIA ELECTRIC'S EDDYSTONE 1 AND 2 are served by one scavenging unit. Normal treatment runs to 30% of flow



BALTIMORE GAS AND ELECTRIC'S C P CRANE 1 has 100% condensate scavenging influenced by brackish cooling water



LOUISIANA POWER & LIGHT'S LITTLE GYPSY UNIT is the only recent drum-boiler unit that uses 100% condensate scavenging

Utility plant	Blowdown	Nominal condensate flow, gpm	Filters: Type	No.	Area each, sq ft	Normal flow rate, gpm per sq ft	Maximum flow rate, gpm per sq ft	Condensate treated, %
Ohio Power Co, Philo No. 6	no	1030	tubular	4	50	2.0	4.0	60
Cleveland Electric Illuminating Co Avon No. 8	no	2500	tubular	2	240	2.6	5.2	50 to 100
Philadelphia Electric Company Eddystone No. 1 and 2	no	(1)4000 (2)4500	leaf	3	400	1.25	2.5	25 to 50
Indiana & Michigan Electric Co Breed Plant	no	3750	tubular	4	250	3.75	—	100
Ohio Power Co, Sporn Plant	no	3750	tubular	4	250	3.75	—	100
Southern California Edison Co Huntington Beach No. 3 and 4	no	2900	leaf	3	400	2.5	3.6	100
Baltimore Gas & Electric Co Crane No. 1	no	1860	leaf	2	125	3.5	7.0	100
Tennessee Valley Authority Colbert No. 5	no	4900	tubular	3	415	4.0	—	100
Louisiana Power & Light Co Little Gypsy No. 1	yes	2400	leaf	2	300	4.33	—	100
SME, Naples, Italy, No. 1 and 2	no	2200	tubular	2	280	2.5	5.0	65 to 100
Tennessee Valley Authority Paradise No. 1 and 2	no	6900	leaf	4	400	4.3	—	100
Public Service Electric & Gas Co Sewaren No. 5	no	4800	tubular	3	400	4.0	—	100

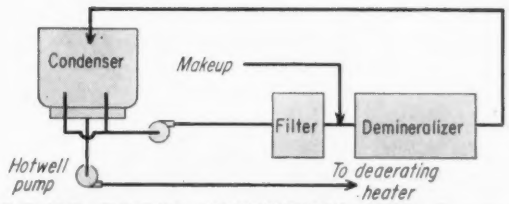
Scavenging units to clean up cycle condensate were mothered by the lack of blowdown provision in supercritical and some subcritical steam generators. Solids removal in the steam generator is impossible, so "kidney" operation, where condensate-scavenging units continuously polish part or all the cycle condensate, keeps solids content to an acceptable maximum.

Quick check of current designs, above, shows wide variations. But arrangement usually includes some form of prefiltration, then a mixed-bed demineralizer followed by a resin trap or postfilter. Current performance standards for condensate scavenging units require:

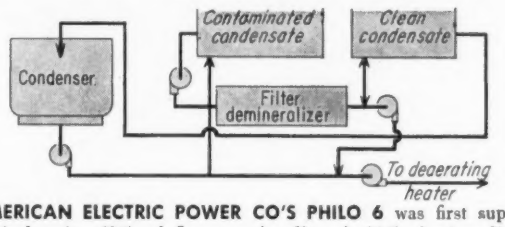
Total solids	40 to 50 ppb
Copper	5 ppb
Iron	5 ppb
Silica	5 to 10 ppb
Conductivity	0.10 micromhos

Condensate-scavenging units come right after the condenser in most normal cycles. Here pressures and temperatures permit use of commercially available resins in the mixed-bed demineralizer.

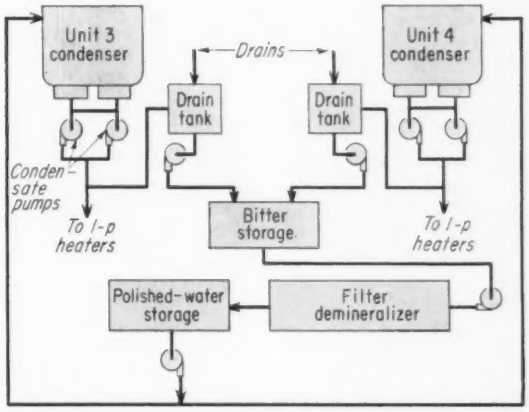
Big design controversy today is amount of condensate to be scavenged—percent of total flow. Typical units above run all the way up to 100%, but this extreme



CLEVELAND ELECTRIC ILLUMINATING'S AVON 8 normally scavenges 50% of condensate flow, can handle 100% flow



AMERICAN ELECTRIC POWER CO'S PHILO 6 was first supercritical unit; 60% of flow can be filtered, 20% demineralized



SO. CALIF. EDISON'S HUNTINGTON BEACH 3 AND 4 have split hotwells so that the scavenging unit can handle small leaks

Demineralizers

No.	Area each, sq ft	Normal flow rate, gpm per sq ft	Maximum flow rate, gpm per sq ft	Condensate treated, %	Regeneration method	Startup date
2	9.5	11.0	11.0	20	in place	1957
3	85	7.5	15.0	50 to 100	in place	1959
3	100	5.0	10.0	25 to 50	in place	(1)1959 (2)1960
3	43	10.0	11.6	35	in place	1960
3	43	10.0	11.6	35	in place	1960
3	75	28.0	56.0	100	external	1960
3	63	10.0	15.0	100	in place	1961
2	78	31.2	31.2	100	external	1961
2	50	26.0	52.0	100	external	1961
2	57	12.5	25.0	65	in place	1961
3	78	29.3	29.3	100	external	1962
2	96	25.0	50.0	100	external	1962

Additional points on current design practice

Tabulation at left does not include some older units where condensate scavenging gave mixed results. In these cases bypass flow was very small or not all components were included that would be considered necessary in a modern system. Also excluded are some subcritical steam generators provided with a vertical drum type steam separator which can double in brass as a blowdown, making condensate scavenging less essential.

Nuclear plants, too, have been omitted from the tabulation. But nevertheless condensate scavenging plays an important part in their design. Here, however, the special case of radioactive-particle removal is part of their justification—perhaps the controlling part.

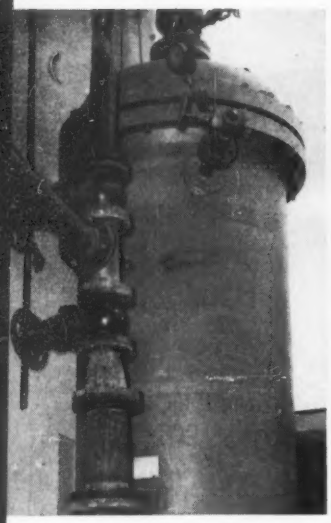
is probably not needed unless sea water from a condenser leak is a hazard. Then 100% scavenging will permit orderly shutdown of unit if break is bad and sea-water infiltration is high. Or if leak is small it will permit continued operation until a convenient time for tube repair. Where two power units are served by one condensate-scavenging system, system can be designed to bypass a percentage of total condensate flow of both units on a normal-throughput basis. Then if trouble crops up — condenser leakage — scavenging system is taken off one unit and handles up to 100% of cycle flow from the leaking unit on an emergency-rate basis.

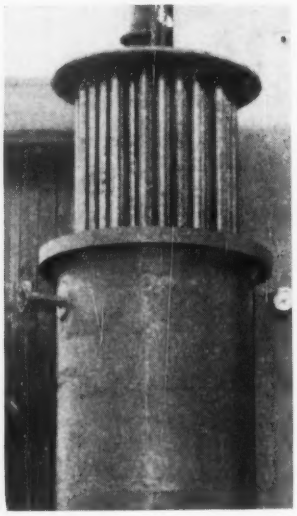
If fresh water is used for condenser cooling, bypass scavenging of something less than 100% is probably the economic break-even point. But precisely where is this point? Only a complete study of equipment and operating costs will show you.

In drum type units the dire necessity of no blowdown does not exist. Nevertheless, justification can frequently be found in reduced long-term line and component corrosion, and in sustained operating efficiency because there's less solids deposition on turbine blading. Startup time can be shortened by scavenging suspended iron and copper oxides immediately after acid cleaning.

continued

Precoated filters, mixed-bed demineralizers are principal





TUBULAR-ELEMENT FILTER has many effluent-headered filter tubes precoated with a filter aid. Cleaning is air-water backflush

WOUND FILTER ELEMENT uses trapezoidal wire to give minimum spacing at element surface. Nozzle effect at surface aids backflush

Condensate filtration in scavenging systems protects the downstream demineralizer from crud—suspended solids collected in the cycle—and is especially important during station startup. Here filter runs between cleanings may be as short as a half hour, but once the cycle has cleaned itself out, runs of a week are not uncommon. Length of filter run is usually limited by a preset pressure differential across the filter. Starting very low, pressure drop may go as high as 30 to 50 psi. At this point the filter should be backflushed and precoated.

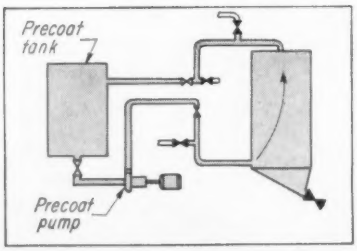
All large condensate-scavenging systems installed to date include filters. Yet controversy exists as to their actual necessity—the demineralizer resin bed can do a good filtering job. But demineralizer filtration can quickly lead to resin-bead fouling and reduced ion-exchange capability. During startup and condenser-leakage periods fouling is aggravated, at the very time top operation of your condensate-scavenging system is most needed. Since resins are very expensive, a filter is usually warranted.

Tubular filters contain many wire-wound elements operating in parallel. Trapezoidal-cross-section wire is wound around a supporting frame at about 0.003- to 0.005-in. spacing. Wire surface supports filter aid and at the same time leaves adequate area for condensate flow.

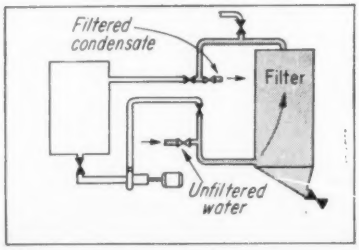
During backflush this special wire shape has a nozzle effect at the interface between filter aid and element itself. Cake is readily cracked off. As a further step to complete backflush, air may be combined with the water. Either station compressed air or air trapped in the filter dome is rapidly expanded by a quick-opening drain valve. Air-water mixture then shatters the cake and washes the filter element free of it.

Leaf type filters are made up of individual double leaves of woven wire. Heavy wire woven to a large mesh backs up and strengthens the fine outside mesh. Condensate enters both sides of each leaf through the filter-aid

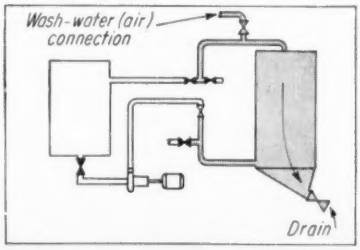
Good precoat: heart of condensate filtration



1 Precoat slurry of filter aid is circulated through filter until effluent runs clear

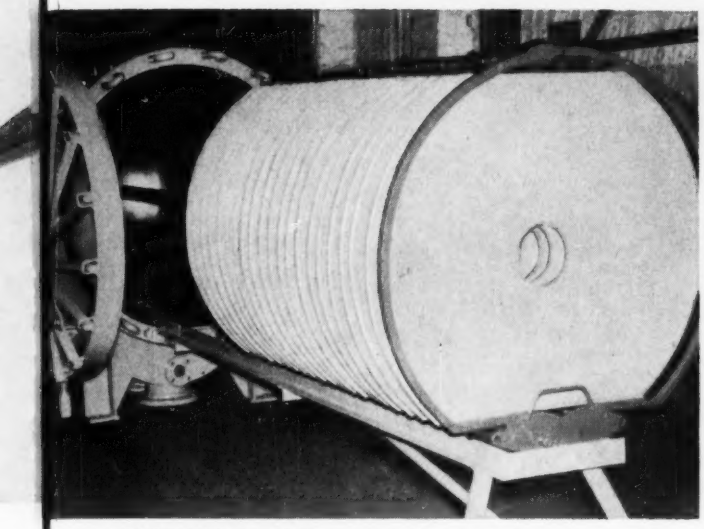


2 During run, solids are collected on filter aid. High pressure drop limits run

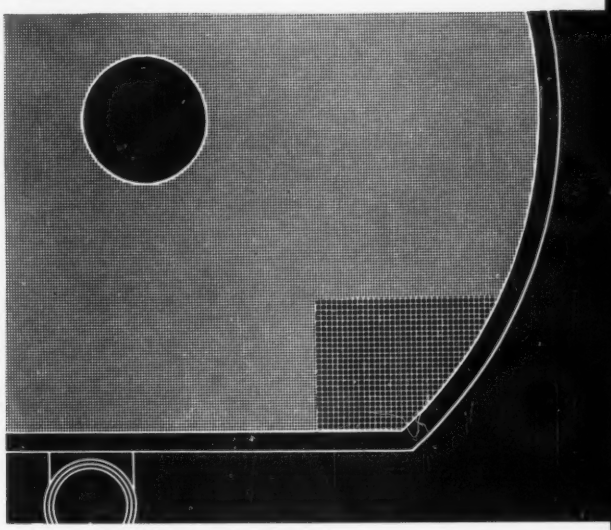


3 Backflush or jetting removes spent filter-aid cake, thoroughly cleans filter

parts of modern condensate-scavenging systems



LEAF-ELEMENT FILTER opens quickly for inspection of filter surface. Water jetted on leaf surface removes spent cake



WOVEN-WIRE LEAF has several meshes for strength. Filter aid coats both sides and flow is from outside in, to headered outlet

precoat. During backflush, revolving jets train on both sides of each leaf, washing off spent filter-aid cake, which then drains to waste.

Cellulose fiber and sometimes carbon are used for filter-aid precoat in condensate-scavenging systems. Diatomaceous earth is currently considered impractical in condensate scavenging because it would introduce silica into the system, unnecessarily loading the demineralizer. Either filter aid gives very fine filtration; any particle larger than one micron will be filtered out.

Body feed—continuous feed of minute amounts of filter aid during run—is not used in condensate filtration. Experience to date indicates it does not lengthen filter runs here as it does in some other filter applications. But more experience is needed to clarify this.

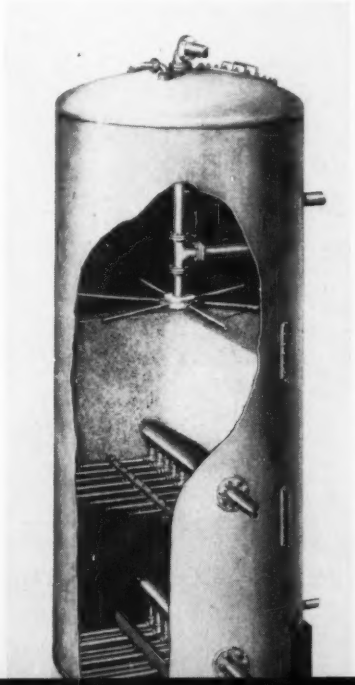
When changing from precoat to run, be sure to maintain a reasonable flow through the filter. If you don't, filter aid may loosen or even drop away from filter elements. Then condensate will flow through the bare filter element and proper filtration is impossible.

Demineralizer completes scavenging picture

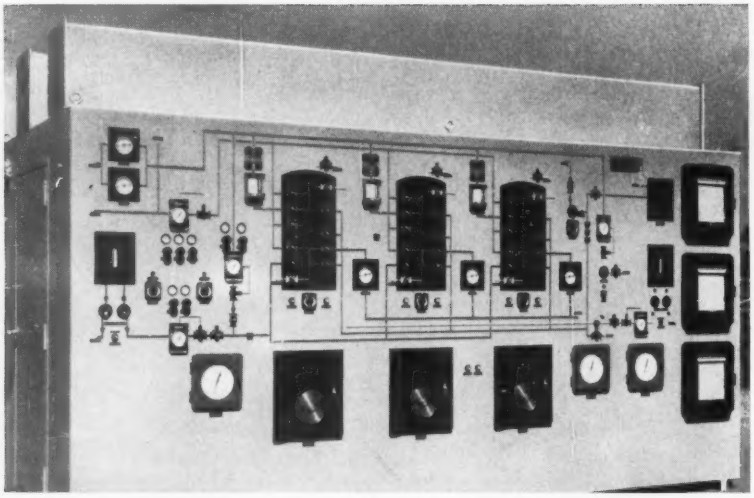
Mixed-bed demineralizers in condensate-scavenging systems differ only slightly from normal makeup practice (see POWER, Dec 1958, pp 98 to 100 and Feb 1958, pp 71 to 78). Main differences lie in regeneration, throughput rates, run lengths.

External regeneration of resins is gaining ground in condensate-scavenging systems. It increases unit capacity by cutting downtime, ups system's ability to meet emergencies by permitting rapid injection of newly regenerated resins. Hydraulic and hydropneumatic resin transfer gives easy classification for regeneration. It also mixes the resin beads for reuse. Transfer does not appear to damage resin beads significantly, but resin traps or postfilters are usually provided to catch any breakage. Another advantage: acid and caustic regenerants are effectively excluded from the main condensate cycle.

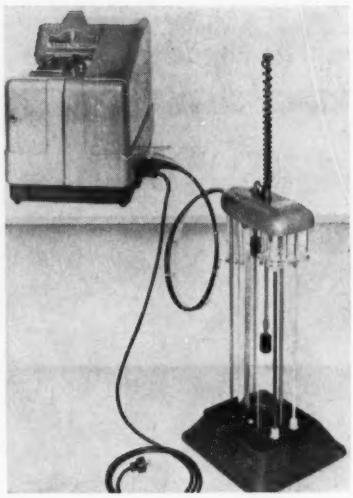
High flow rates are increasingly used in condensate-scavenging demineralizers. Latest units handle up to 50 gpm per sq ft, vs 10 gpm a very few years ago. This means smaller less-expensive shells to handle full condensate flow. Runs of several weeks with high flow rates are not uncommon after power cycle has been cleaned. In low-flow-rate units some runs have extended to several months.



MIXED-BED DEMINERALIZER designed for in-place regeneration——►



DIAGRAMED CONTROL PANEL for condensate-scavenging unit shows all major components and flows. Actual controls are located as in system; performance data is shown



TAPE ANALYZER continuously shows solids content of over 450 millimicrons

Control of condensate-scavenging units varies from manual to fully automatic, but degree of automation usually agrees with philosophy for the remainder of the plant. Panel above is typical of modern practice for controlling a mixed-bed demineralizer with in-place regeneration. Panel shows all major components are in their relative positions; flows between them are colored for easy identification. Actual controls on panel are located as they are placed in system. Important performance data—conductivity, flows and run times—are shown at convenient locations.

Panel may be located near the scavenging plant or may be remote, as in the station control room. In fully automatic plants, an operator can use the panel to manually take over control of the condensate-scavenging system during an emergency situation.

Effluent quality from modern condensate-scavenging systems is extremely high. In fact, usual techniques common but a few years ago to measure quality are now completely inadequate. More-complex methods have been developed to meet this need. Among them: the millipore tape which filters out practically all suspended solids —passing only those smaller than 450 millimicrons. A fixed volume of condensate passes through the tape and solids content is readily apparent from the color and density of the deposit. An automatic machine continuously runs millipore samples. With date and time automatically stamped on the tape, these become a permanent record of scavenging operation.

Other quantitative methods commonly used to measure effluent quality:

Silica—molybdate method

Iron—bathophenanthroline

Copper—diethyldithiocarbamate or bathocuproine

All these are colorimetric, but a spectrophotometer with a photomultiplier must be used to measure the slight color changes involved. Careful technique and clean apparatus are a must to avoid misleading results.

Where will scavenging go from here?

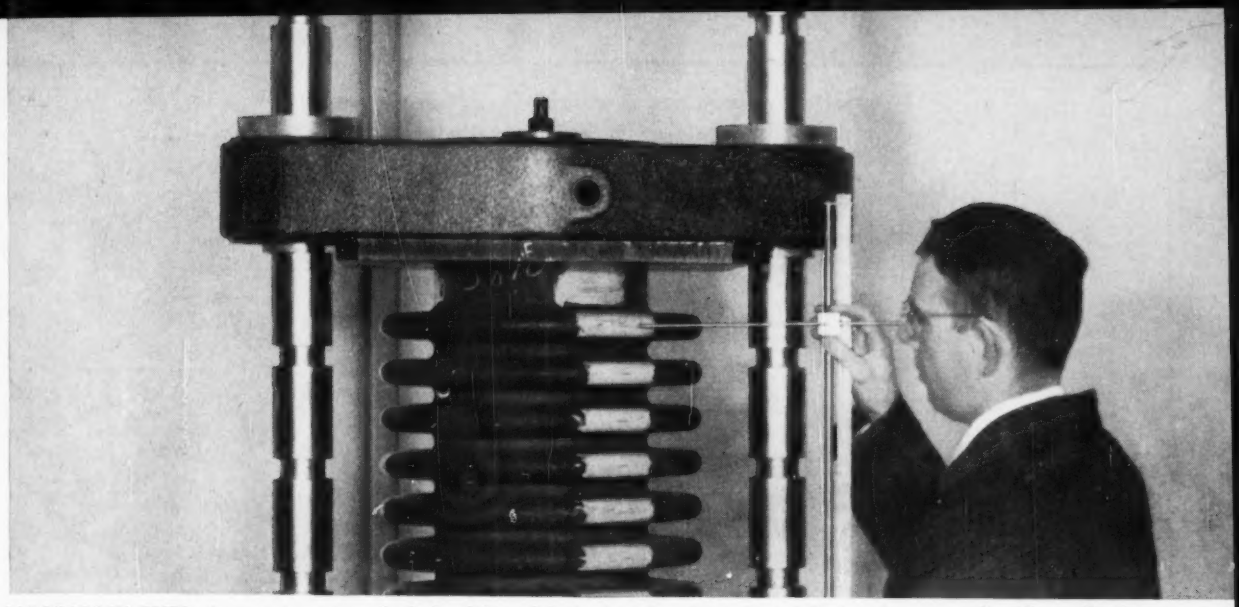
Many units are now running, and condensate scavenging has come of age. Benefits derived in once-through steam-generator units, where it is mandatory, extend to drum type boilers and may well be available in units operating as low as 1800 psig. But what's the next step?

We seem to be on the threshold of a revolutionary reappraisal of condensate treatment. Heretofore we have concentrated on makeup treatment, dealing with about 1% of the cycle flow. We have relegated the other 99% to some form of internal treatment. The reverse of this now seems more promising. How do we do it?

(1) High-flow-rate condensate scavenging —bypass or full flow depending on condenser circulating water—combined with minimum makeup-water treatment may increase capital investment only slightly. But it can add immeasurably to operating efficiency and reduce maintenance.

(2) To ease pH control and eliminate the present compromise between ferrous- and nonferrous-metal environment, an all-steel cycle, at least downstream from the scavenging unit, is indicated.

(3) To complete the picture, no-solids internal treatment—ammonia and hydrazine —holds pH closely and minimizes corrosion by scavenging O_2 traces. (Don't forget effective O_2 removal in a deaerating heater or specially designed condenser hotwell *or both* is part of this picture.)



LABORATORY TESTS of expansion joints checked validity of basic formula, also indicated limits of accurate formula application

Evaluation of expansion-joint behavior

Overestimating force-deflection ratios for expansion joints can boost piping cost. Here's a guide to proper piping calculations

By ALEXANDER SAMOILOFF, Badger Manufacturing Company

Design of piping systems, particularly high-temperature high-pressure systems, calls for careful balances of stresses and deflections throughout. Expansion joints contribute an important part to this balancing operation. Their proper application can result in substantial savings in cost of piping and supports.

Although piping-system designers should not concern themselves with detailed analyses of expansion joints, they must evaluate the force-deflection relationship of each joint in order to calculate loading and deflection of pipe hangers, fixed supports, etc.

Wherever possible, these force-deflection ratios should be obtained from the expansion-joint manufacturer. In many cases system designers who have attempted to calculate these ratios overestimated hanger and support stresses. This resulted in excessive system costs, overly rigid supports and under some conditions could result in system vibration.

To help you sidestep this problem of overdesigning piping supports, we would like to show you how we calculate force-deflection ratios. We will use our formulas to point out important facts in expansion-joint design.

In design of any piping system, you must provide flexibility to absorb thermal expansion or contraction of piping resulting from either ambient-temperature changes or temperature changes induced by flow through the piping. This flexibility can be achieved either by the use of piping loop systems, or by installing one or more expansion joints.

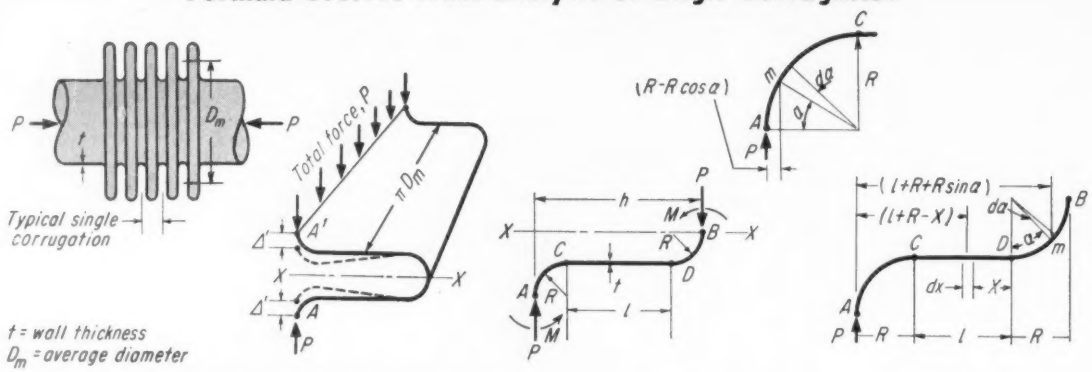
Piping loop systems are space consuming, so it is seldom practical or economical to use them where space is limited. Even when adequate space is available, cost of expansion loops or bends may exceed cost of comparable expansion joints, except for small-diameter piping. Consequently, more and more piping designers are using expansion joints to solve problems of thermal expansion arising from industry's constant demands for ever-higher operating temperatures.

Expansion joints divide into two general classifications: slip type and packless or bellows type. The packless, corrugated, metal expansion joint is most frequently used in modern piping applications. It requires no maintenance and its inherent flexibility permits greater freedom in piping design than the slip type expansion joint which is restricted entirely to axial movement.

Since design engineers are primarily interested in the magnitude of the forces required to compress or extend a packless, corrugated expansion joint, our problem is to establish the relationship between deflection of a joint and the force required to produce this deflection.

Corrugated expansion joints can be used for practically any kind of movement: axial, angular, lateral and various combinations. Axial movement is the fundamental one. Formulas developed for it are used as the basis for deriving formulas for other

Formula evolves from analysis of single corrugation



Total deflection per corrugation Δ equals $2\Delta'$ as shown. To balance forces P, introduce couples M of $Ph/2$ magnitude at points A and B of half the strip. Castigliano Theorem is used for determining deflections. See S Timoshenko, *Strength of Materials* Part II, for application of Theorem to curved bars.

$\Delta' = \Delta'_P - \Delta'_M$ where force P causes Δ'_P and couple M causes Δ'_M. Assume point B is a fixed support and force P and couple M are applied at point A which deflects.

Deflection Δ'_P consists of deflections contributed by strip sections AC, CD and DB:

$$\Delta'_P = \Delta'_{PAC} + \Delta'_{PCD} + \Delta'_{PDB} \quad (1)$$

Elastic strain energy of AC is $U = \int_0^{\pi/2} \frac{M^2}{2EI} R\, d\alpha$

where $M = P(R - R\cos\alpha)$

$$\text{So } U = \int_0^{\pi/2} \frac{P^2 (R - R\cos\alpha)^2}{2EI} R\, d\alpha = \frac{0.355\, P^2R^3}{2EI} \quad (2)$$

The derivative of U with respect to P gives deflection

$$\Delta'_{PAC} = \frac{dU}{dP} = 0.355\, \frac{PR^3}{EI} \quad (3)$$

Following similar procedure for Δ'_{PCD} where

$M = P(l + R - x)$ and $U = \int_0^{l} \frac{M^2}{2EI}\, dx$ we get

$$U = \frac{P^2 l}{2EI}\left[(l+R)^2 - (l+R)\, l + l^2/3\right] \quad (4)$$

$$\text{and } \Delta'_{PCD} = \frac{dU}{dP} = 0.333\, \frac{Pl^3}{EI} + \frac{Pl^2R}{EI} + \frac{PlR^2}{EI} \quad (5)$$

Again for Δ'_{PDB}, $M = P(l + R + R\sin\alpha)$

and $U = \int_0^{\pi/2} \frac{M^2}{2EI} R\, d\alpha$. When integrated:

$$U = \frac{P^2R}{2EI}\left[(l+R)^2\pi/2 + 2R(l+R) + R^2\pi/4\right] \quad (6)$$

$$\Delta'_{PDB} = \frac{dU}{dP} = 4.355\, \frac{PR^3}{EI} + \frac{5.14PR^2l}{EI} + 1.57\, \frac{PRl^2}{EI} \quad (7)$$

Adding (3), (5) and (7) we obtain

$\Delta'_P = P/EI\ (4.71R^3 + 0.333l^3 + 2.57l^2R + 6.14lR^2)$ (8)

Now we must find the deflection Δ'_M of point A because of couple $M = Ph/2$. Moment between A & B is constant, so integration is simple:

$$U = \frac{M^2}{2EI}\left[\int_0^{\pi/2} R\, d\alpha + \int_0^{l} dx + \int_0^{\pi/2} R\, d\alpha\right] = \frac{P^2h^2}{8EI}(R\pi + l) \quad (9)$$

$$\text{and } \Delta'_M = \frac{dU}{dP} = \frac{Ph^2}{4EI}(R\pi + l) \quad (10)$$

Δ' can be determined by subtracting (10) from (8), eliminating l which is equal to $(h - 2R)$. So $\Delta = 2\Delta' = 2(\Delta'_P - \Delta'_M)$

$$\Delta = \frac{2P}{EI}\ (0.046R^3 + 0.083\, h^3 + 0.287\, h^2R - 0.144\, R^2h) \quad (11)$$

Moment of inertia of strip $I = Dm\, \pi\, t^3/12$

Substituting I into (11) we get

$$\frac{P}{\Delta} = \frac{EDm\,\pi}{24}\left(\frac{t}{h}\right)^3 C \text{ where} \quad (12)$$

$$C = 1\Big/\left(0.046\, \frac{R^3}{h^3} + 0.083 + 0.287\, \frac{R}{h} - 0.144\, \frac{R^2}{h^2}\right)$$

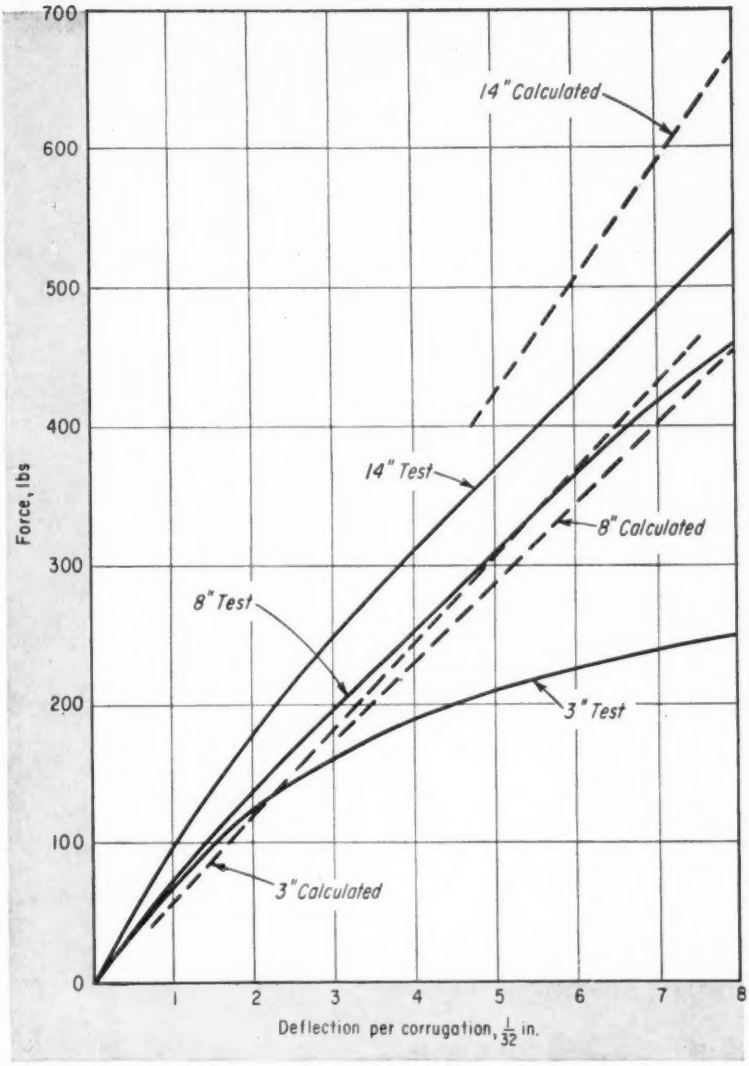
Values of shape-coefficient C for R/h ratio are given in curve, above right.

types of movements. Our investigation will therefore be confined to axial movement, the axial extension and compression of a packless, corrugated expansion joint. Furthermore, since corrugated expansion joints are designed to be used predominantly in compression, we will consider this type of movement first.

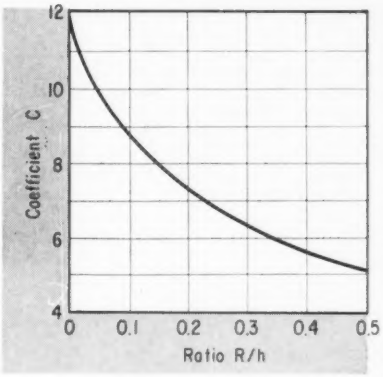
A typical corrugated joint is illustrated above. The joint is subjected to compression by two external forces applied along the longitudinal axis. Joint consists of a bellows having a series of identical corrugations. Thus, our problem may be solved by studying behavior of a single corrugation in compression under action of the forces P. To simplify solution of the problem, curvature of the corrugation is disregarded and is developed into a straight strip π Dm long. This strip is symmetrical about its x axis. So it is possible to consider one half of the strip for our investigation.

The expression shown above would have been obtained if the external force P acted in the opposite direction, causing expansion of the joint rather than compression. Thus the relationship for axial movement derived in equation (12) is a fundamental one which may be used as the basis for deriving similar formulas for the other types of movement.

Chart, above right, shows a series



TEST VS CALCULATED force-deflection ratios show reasonable correlation over part of deflection range. Test deviates from calculated because of nonelastic deformation



SHAPE-COEFFICIENT curve reflects importance of careful joint manufacture

of force-deflection curves for Badger expansion joints in 3-, 8- and 14-in. sizes. Two curves have been plotted for each size of joint; one represents Badger laboratory test data, the other represents values calculated by the use of equation (12). These curves indicate that equation (12) gives remarkably accurate results within the limits of its application.

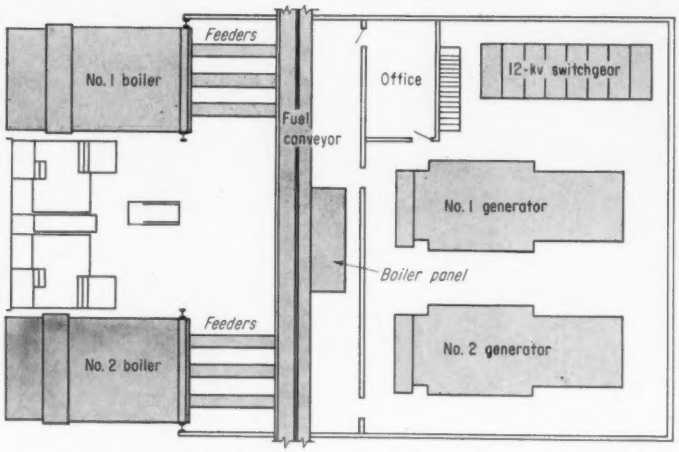
One important factor you must realize: each test curve fell below its companion theoretical curve. As deflection increases, this discrepancy increases. This is simply a result of assuming purely elastic deformation of the expansion joint. At high stress values some plastic deformation occurs in all packless expansion joints. This condition has tripped many piping-system designers and can be the major cause for overdesigned, overly rigid piping. By assuming purely elastic deformation and applying a safety factor on top of theoretical stress requirements, you reach an excessively high stress requirement for supports. It is impractical to try to estimate true deflection on a theoretical basis so you should assume purely elastic deformation, as we did, and limit use of the formula to the deflection range indicated in our chart. For larger deflections you should ask the expansion-joint manufacturer to supply force-deflection data.

Examination of equation (12) reveals that the force-deflection ratio is extremely sensitive to the thickness of the bellows t and the height of the corrugations h, since both of these factors appear as cubes in the equation. Thus even a small change in the bellows thickness or height of the corrugations will result in a substantial change in the force-deflection ratio P/Δ. For example, a 5% change in either t or h will produce a 16% change in the force-deflection ratio. This means that variations in thickness from point to point in a bellows or minor discrepancies in the corrugation heights will produce unequal loading among the several corrugations of any one bellows.

It is also interesting to examine the influence of corrugation shape on the P/Δ ratio. For example, let us assume that the height of the corrugations h is kept constant while the radius R is reduced. We then find from the curve given above that the value of the coefficient C increases as the R/h ratio decreases. This, of course, means that the P/Δ ratio will also increase. In other words, as the radius of the corrugations decreases, the force required to produce any desired deflection increases, providing height of corrugations stays constant.

It is therefore apparent that design of a packless, corrugated expansion joint involves a balance of many factors and requires the skill and knowledge of an experienced expansion-joint designer. Furthermore, extremely precise manufacturing and inspection procedures must be maintained to insure long, trouble-free performance in service.

Semi-outdoor, entirely self-contained

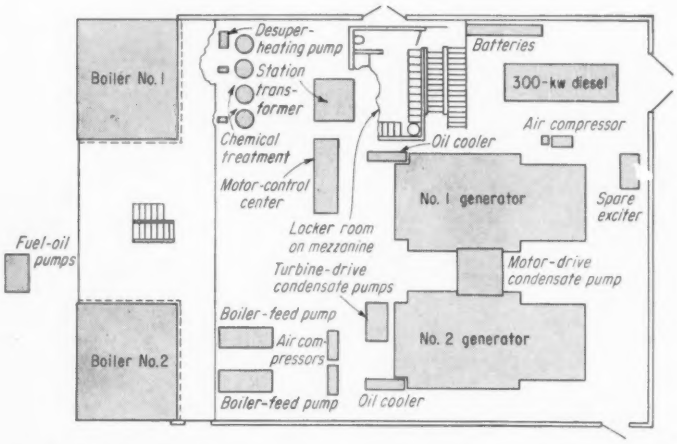


BOILERS are semi-outdoor 85,000-lb-per-hr continuous units. Firing aisle and space between boilers is enclosed. F-d and i-d fans are on outside platform

By J S WHITTON, Project Engineer
Swanson Wright & Co, Engineers Ltd

Spent boilers, higher power costs in the offing. Here's how one plant evaded the horns of this dilemma, now operates economically with . . .

Industrial power from hogged fuel



TURBINE-GENERATORS were shipped from former location in eastern U.S. with attendant piping. Condensers were retubed, stators rewound at plant

Starting up a "grass-roots" power plant in an existing sawmill is somewhat rare these days. But in the case in point increasing power costs and obsolescence of existing units showed a good financial reason for generating power from byproduct fuel. Perhaps other industrial operations faced with a parallel set of circumstances may be able to profit from our experience in setting up a self-sufficient plant.

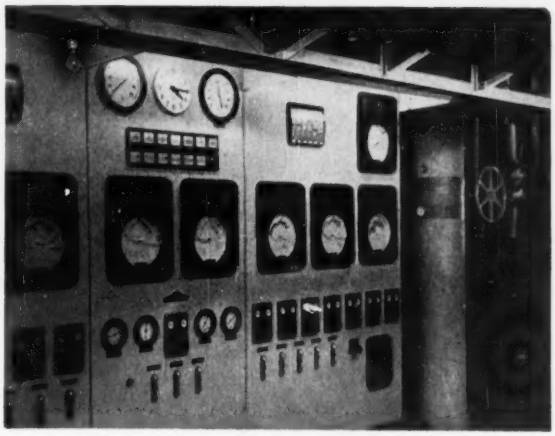
Back in 1958 the Eburne Sawmill Div and Huntting-Merritt Shingle Div of Canadian Forest Products Ltd at Marpole, British Columbia each operated separate mills, although on adjacent properties. Each had its multiple hrt boiler installation for steam supply. The local utility company fed in 12-kv power at each end of the site.

It became increasingly obvious that the boilers in both mills were on their last legs. For some time, management's thinking had leaned toward a central power and steam-generating plant to serve the two mills. Now, detailed surveys showed sound justification for this theoretical thinking.

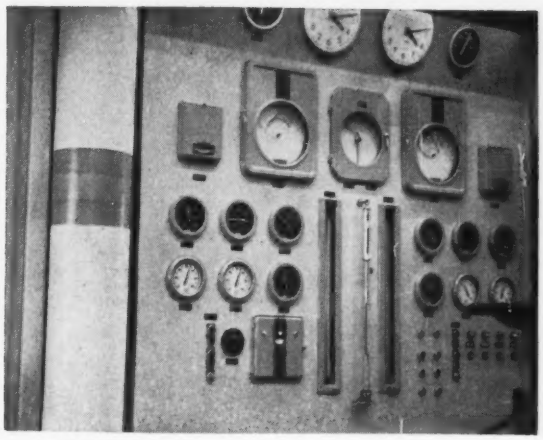
An earlier survey, in 1956, by the consultants pointed the way for the new plant. In 1957 the Huntting-Merritt mill was equipped with a new i-d fan and dust collector sized for a future power-boiler installation. In 1958 a proposed power-rate increase by the utility coupled with the opportunity to acquire two good, used automatic-extraction turbine-generator units made the power-plant project very desirable. Design work commenced without wasting a minute.

Earlier studies showed expected

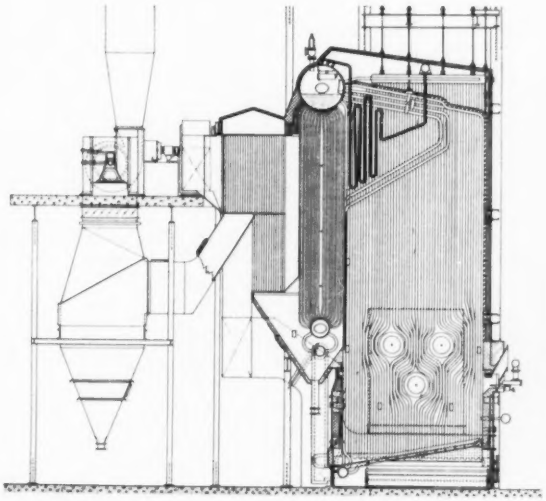
plant couples good design with dependable new and used equipment



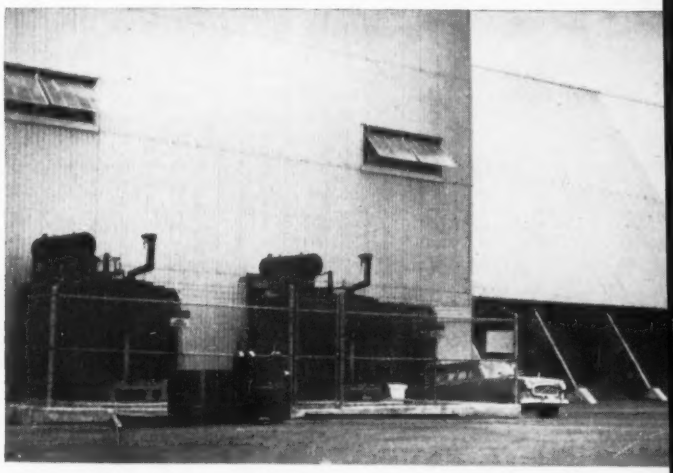
BOILER PANEL has master control for undergrate-air and fuel-feeder. O_2 recorder controls overfire air, resets feeder speed



TURBINE CONTROLS are grouped on own panel back-to-back with boiler board. Alarms here activate annunciators on main board



BASE FUEL is hogged wood, shavings, sander dust, etc, fed from storage to pneumatic stoker. Side-mounted oil burners stand by



FUEL-STORAGE BIN is an A-frame unit, with glued laminated beams. It needs no pressure walls except in the bottom ten ft

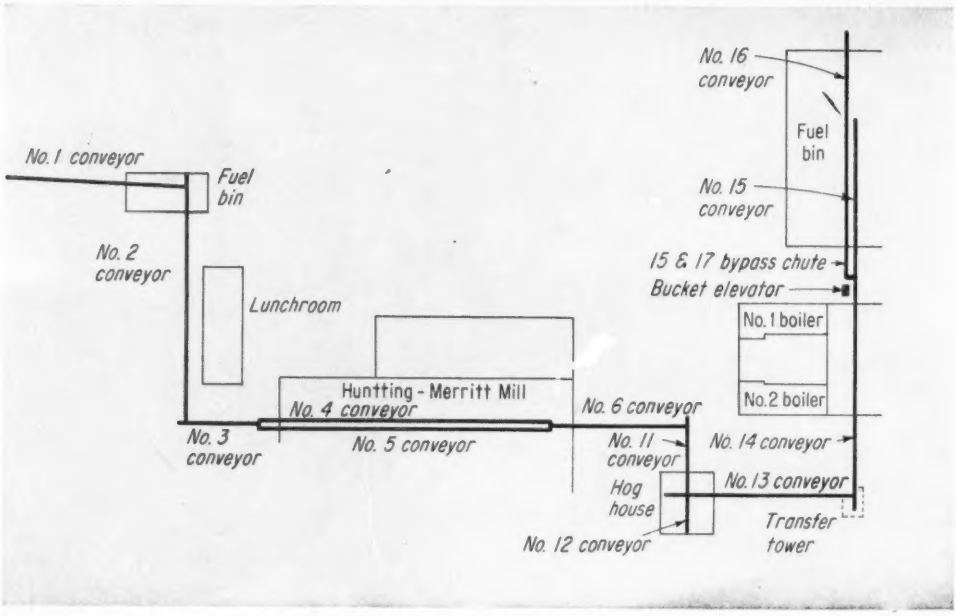
plant load of 80,000 lb per hr of 165-psi steam and power load of about 7200 kw. The two available turbine-generators were 4750-kw units designed for 400-psi 650-F throttle conditions with automatic extraction at 165 and 2 psi. Two hog-fuel-fired boilers were specified, each for 85,000-lb-per-hr output at 400 psi, 650 F. These would give some additional capacity for plant expansion; estimated expenditure of $1.5 million would show a 4-yr payoff.

As originally conceived, the plant was a low-first-cost rapid-writeoff project. But the owners decided to build on a quality level consistent with their processing equipment, especially as their operation would depend entirely on the new plant. Thus, with reliability a requirement, the plant was laid out with two boilers equipped with standby burners for heavy-oil firing and two turbines plus a 300-kw diesel-driven generator for station emergency use only.

Boilers are semi-outdoor, with firing aisle and space between the units enclosed. Turbine room is completely enclosed. Transformers are outdoors, as are the boiler fans. Plant was originally designed for a minimum operating crew of four men per shift, including one man reclaiming fuel. Design changes and additional equipment installation meant more investment in controls and remote operations to hold to original personnel requirements.

The new plant was backed up to the newly installed i-d fan and dust collector at the H-M mill—collector and

Far-flung conveyor network cuts fuel handling;



WASTE SYSTEM channels to a single conveyor, leads through a metal detector to hog house. Fuel not needed immediately goes to storage, later onto a below-grade conveyor which carries it to bucket elevator

stack could be used for the new No. 2 boiler by rotating the dust collector through 180 deg. This put the main plant in a desirable area for running steam and power lines to the other mills. Steam lines to Eburne were suspended from prestressed wire rope supported on poles which also carried the 12-kv distribution line. In addition, system carried an 8-in. pneumatic conveyor for shavings. The layout allowed comparatively short cooling-water lines, with cooling-water pumphouse spotted in a protected slough formed by an island and a solid causeway. Cooling-water discharge goes to the upstream side of the causeway.

Fuel-quantity studies, largely educated guesses as always, showed hogged fuel from Eburne's No. 3 mill and the H-M shingle mill should provide correct amount of fuel for full boiler loads. Fuel is about 30% gangmill waste, mostly bark and sawdust from fir and hemlock; remaining 70% is cedar-shingle waste consisting of shingle hay, blocks, sander dust.

Entire waste system channels to a single conveyor, leads through a metal detector and into one of the two 58-in. Mammoth Eat-Rite hogs. The hogged fuel then feeds to the boiler-house conveyor. Fuel not needed immediately goes to storage; it can be reclaimed by a front-end loader, put on a below-grade conveyor, carried to a bucket elevator. The hogged-fuel storage bin is an A-frame structure of glued laminated beams covered with galvanized sheeting, eliminating need for pressure walls except in the bottom ten ft. Green shavings from the planer mill can be blown over to another conveyor, then into the fuel bin to add to fuel quantity and quality.

Boiler-house conveyor is a double manganese chain conveyor on cast-iron wear plates with maple flights. It insures a clean drop from conveyor to feeders. Others are low-manganese single-chain flights.

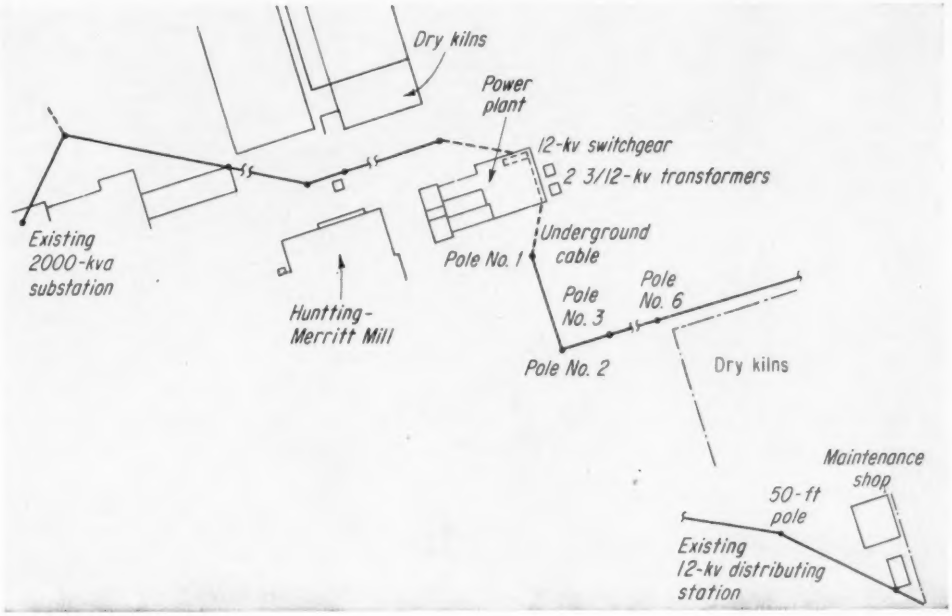
The new boilers are 2-drum baffleless 85,000-lb-per-hr continuous-rating units equipped with pneumatic spreader stokers and pinhole grates. Installation has a 500-F outlet-temperature air heater; there's provision for an economizer. 20% of total air is available as high-pressure overfire air. Cinder-return fans also operate at high pressure to promote turbulence in the combustion chamber.

Fuel-oil burners are located in the boilers' sidewalls, fired from a mezzanine between operating floor and basement. F-d and i-d fans, latter turbine-driven, are spotted on an outdoor platform. A 170,000-lb-per-hr deaerating heater operating at 30 psi and having 20-min storage capacity is located on the roof.

Makeup is Vancouver City water, 30-ppm total solids, fed directly to the deaerator. Caustic and sulfite injection at the deaerator outlet and direct phosphate injection into the steam drums treats the water.

Combustion controls were designed for a master pressure control to directly control undergrate air and to set the fuel feeders by means of a proportioning relay. O_2 recorders directly control overfire air to compensate for fluctuating fuel quality and reset fuel-feeder speed. Fuel feeders are driven by a variable-speed motor.

central plant simplifies energy-systems arrangement



NEW PLANT backed up to recently installed i-d fan and dust collector at H-M mill puts plant in good spot for running steam and power lines to other mills. Poles also carry an 8-in. pneumatic conveyor for shavings

They consist of six strands of chain on about 10-ft. centers. A separately driven high-speed-takeoff spiked roll provides uniform feed rate to the pneumatic spreaders.

A standard 3-element unit controls boiler-water level. I-d-fan inlet damper controls furnace draft. A constant-pressure control on the f-d-fan plenum compensates for varying demands of undergrate and overfire air.

Turbine controls are grouped on their own panel which backs up to the boiler panel using a common maintenance aisle. Pressure and temperature alarms on the turbine panel activate annunciators on the main board. Extraction steam from the turbines or from a reducing station on the main header goes directly to plant auxiliaries at 550 F. Process steam goes to a mechanical atomizing desuperheater. Turbine condensate from 30-psi steam drains, pumped by a 2-stage turbine pump, supplies process water. Any failure of this unit would cause an automatic cut-in from the feed-pump discharge line.

Cooling-water pumps are single-stage deep-well units. Main runs of inlet and discharge piping are wood stave, remainder is asphalt-coated steel pipe. Fuel-oil pumping and heating set has both a steam-reciprocating and a motor-driven gear pump, together with heaters and controls.

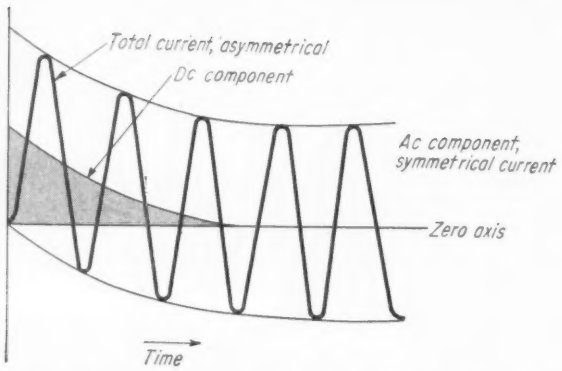
Turbine-generator units were purchased in the eastern U.S. Attendant piping was shipped with them and machines were relocated at the same center-line distance so most of the piping could be reused without modification. Machines were overhauled on arrival by Eburne maintenance personnel. All parts were thoroughly checked and renewed where necessary. This crew retubed the condensers, also rewound both generator stators under supervision of the manufacturer's representative. All rotating parts were dynamically balanced on site before assembly. The standby diesel-driven generator is a 300-kw unit connected directly into the 440-v motor-control center.

Main generators are 2300 v, delta connected; bus ducts connect them to 4500/6375-kva 2.3/12-kv transformers. The 12-kv switchgear, located on the operating floor, consists of two plant feeders and a station feeder. Plant feeders supply existing substations directly and the station feeder supplies a motor-control center through a 12/.46-kv transformer. All power-plant wiring was done by Eburne personnel. Utility-company power has been disconnected from both substations.

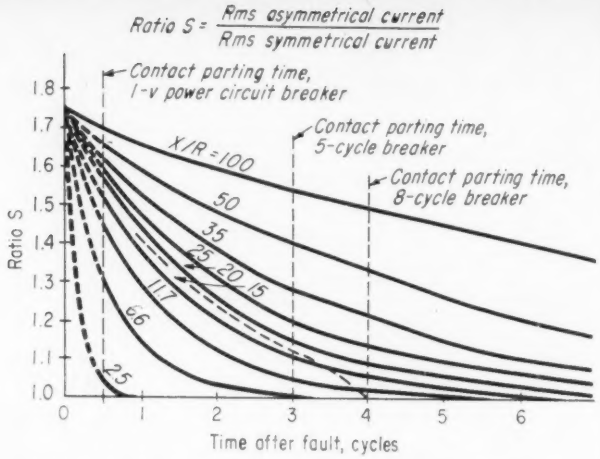
A separate hog house was built with its own motor-control center fed from the H-M distribution center. The center also feeds two hogs and several conveyors in the vicinity.

Steam tracing was used as required on external lines; these were kept to a minimum. Main feed line and superheater header drain on each boiler plus the four control connections on the deaerating heater were the only lines requiring tracing.

In operation just about a year, the plant is a workhorse, steadily pulling the entire mill steam and electrical load. Its performance has fulfilled design expectations and has justified the investment.



ASYMMETRICAL CURRENT has ac and dc components. Ac component adds contributions of transformers, generators and motors



RATIO of maximum rms asymmetrical short-circuit current to rms symmetrical varies with time for several values of X/R

Methods of rating power circuit breakers on a symmetrical basis have been developed by AIEE and proposed as a new ASA Standard. Let's see how proposed methods compare with existing techniques for applying . . .

Industrial circuit breakers

By P L CAMP and J D WOOD, I-T-E Circuit Breaker Company

Adequate short-circuit protection is essential to industrial power-distribution systems. Equipment costs can be excessive if you specify unnecessary interrupting capacity (IC), but inadequate equipment can mean disaster.

Choice of equipment begins with determining short-circuit currents available throughout your system. AIEE publication 952, *Electric power distribution for industrial plants (Redbook)*, outlines accepted methods. Subject is also tackled in POWER's special report, *Electrical Distribution Protection*, June 1958.

Fault current, in usual approach, is considered limited by system reactance X. Resistance R, small compared with X, is usually neglected. Short-circuit current is system voltage E divided by system reactance X at point of fault. Using E/X value for direct comparison with equipment ratings, however, is complicated by the property of fault current called *asymmetry*.

Current asymmetry is explained in the *Redbook* and the POWER special report. In effect, when a fault occurs at or near zero voltage the fault current is displaced from the zero-current axis, above left. You can visualize this offset as a symmetrical ac component superimposed on a dc component. Dc component is initially equal in magnitude to instantaneous value of symmetrical ac component at time of short circuit.

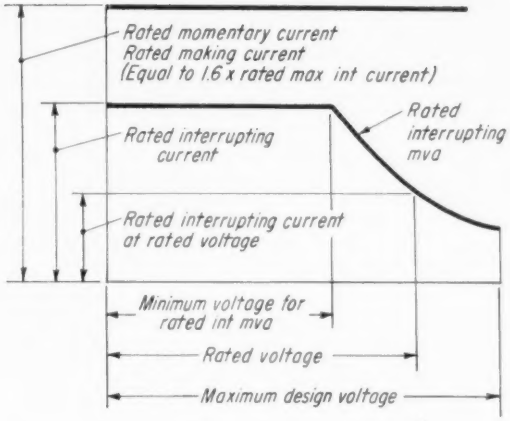
Dc component decays with time if there is any resistance in the circuit. Higher values of R speed decay. Ratio X/R determines decrement of short-circuit current, above right. Therefore, X/R influences determination of total current at any time after initiation of fault current.

Rating of every short-circuit protective device that can be applied in industrial power-distribution systems must recognize the asymmetry of a short circuit. Present and proposed ratings of power circuit breakers are compared at top of next page. In the proposed method of

Do new standards fit industrials?

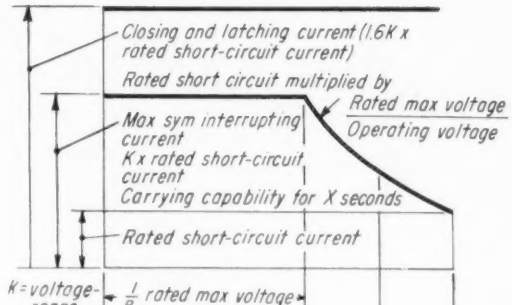
Proposed standards and accompanying application guide, last page, have stimulated great interest among engineers, particularly as to their suitability for industrial electric-distribution systems (POWER, April 1960, p 101). In this article the authors discuss how standards may be interpreted for industrial-system protective applications above 600 volts.

How circuit-breaker ratings match short-circuit characteristics


Rated momentary current
Rated making current
(Equal to 1.6 x rated max int current)
Rated interrupting current
Rated interrupting mva
Rated interrupting current at rated voltage
Minimum voltage for rated int mva
Rated voltage
Maximum design voltage

Present

Circuit breakers handle faults within their *rated interrupting mva* between limits of *maximum design voltage* and *rated maximum interrupting amperes.* Because fault-current asymmetry exists it's necessary to indicate to what degree breaker can withstand maximum possible rms current (including both ac and dc components) available immediately after fault initiation. This is determined by *rated making current* and *rated momentary current* of breaker. Asymmetry requires that *rated interrupting time* be specified since from this rating critical breaker characteristic of contact-parting time is derived. Degree of asymmetry at contact parting must be factored in.


Closing and latching current (1.6K x rated short-circuit current)
Rated short circuit multiplied by
Rated max voltage / Operating voltage
Max sym interrupting current
K x rated short-circuit current
Carrying capability for X seconds
Rated short-circuit current
K = voltage-range factor
1/K rated max voltage
Nominal voltage
Rated maximum voltage

Proposed

Basic difference in concept: interrupting rating changes from mva (*rated interrupting mva*) to amperes (*rated short-circuit current*). Further modification introduces *voltage-range factor* (K). *Rated short-circuit current* becomes basic quantity which, multiplied by *rated maximum voltage* divided by operating voltage, represents breaker capabilities at operating voltage. K factor is used to determine maximum symmetrical interrupting current (K times *rated short-circuit current*) and minimum voltage to maintain full interrupting capacity ($1/K$ times *rated maximum voltage*) as well as to determine closing and latching ability (1.6 times rated short-circuit current).

rating, a circuit breaker is capable of handling fault current between rated *short-circuit current* at *rated maximum voltage* and K times *rated short-circuit current* at $1/K$ times *rated maximum voltage,* value depending on value of operating voltage.

Proposed ratings change another concept: circuit breakers are required to have a factor "built into" their interrupting rating to take care of contact-parting speed. This additional capacity is indicated in ratio-S graph, opposite page, by dashed line lying approximately along the $X/R = 15$ line. These are all the factors you need to consider when making an application study to account for time of breaker-contact parting.

Note also: if relays have as much as four cycles delay the circuit breaker will open symmetrical current. Since you'll meet these settings frequently in industrial plants, there's provision to demonstrate this ability separately under the new rating.

Application procedure for a power circuit breaker under today's rules requires the following checks:

First—breaker *maximum design voltage* must always be higher than system operating voltage.

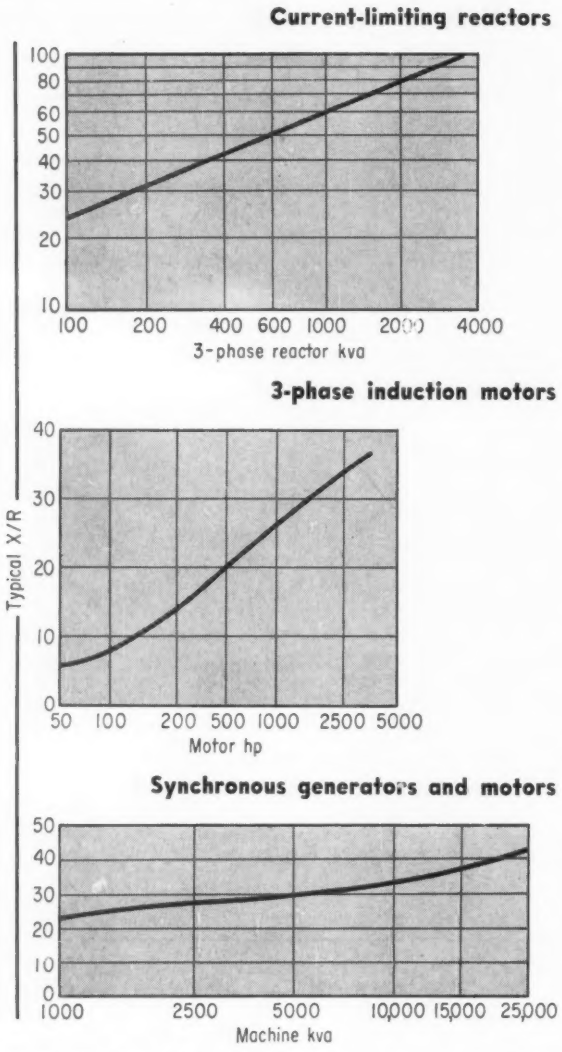
Second—breaker *rated interrupting mva* should exceed system capabilities. Determine capabilities by constructing a reactance diagram of the system and solving for symmetrical short-circuit mva at point of application. Use the reactances that exist at time of breaker-contact parting. For 5- and 8-cycle breakers in today's industrial plants, reactance of induction motors is neglected; transient reactance of induction motors is used; subtransient reactance of generators, synchronous condensers.

You can compare symmetrical short-circuit interrupting mva thus determined directly with circuit-breaker ratings, provided: (1) breaker has a *rated interrupting time* of 8 cycles or more (2) symmetrical short-circuit capability of system is less than 500 mva. In both cases dc component is considered to have disappeared before contact parting.

If breaker has a rated interrupting time of 5 cycles, circuit asymmetry is factored in by multiplying symmetrical short-circuit mva by 1.1. If system capabilities top 500 mva, system X/R is considered high enough so that some dc component may still be present; factor of 1.1 is applied to system symmetrical s-c mva for usual 8-cycle application, 1.2 for 5-cycle breakers.

Derivation of these multipliers is clarified by inspecting ratio-S graph, first page:

(1) The 8-cycle breaker has a contact parting time



AVERAGE *X/R* for typical 3-phase synchronous generators (solid rotor and salient-pole), motors; induction motors; reactors

of 4 cycles. With system X/R of about 10 at 4 cycles after fault (a practical maximum for an installation of 500 mva or less interrupting), factor is 1.02 (1.0).

(2) With system X/R of about 20 at 4 cycles after fault, as it might be in a system with interrupting mva over 500 mva, factor for 8-cycle breaker is 1.08 (1.1).

(3) The 5-cycle breaker has contact-parting time of 3 cycles. With system X/R of about 15 at 3 cycles after fault (practical maximum for installation of 500 mva or less) the factor is 1.09 (1.1).

(4) With system X/R of about 25 at 3 cycles after fault, as might be found in system over 500 mva, 5-cycle breaker's factor is 1.2.

Third—breaker's rated maximum interrupting amperes should never be exceeded even though there is margin below *rated interrupting mva.* There's no danger unless system operating voltage is below breaker *minimum operating voltage* at rated mva.

Fourth—breaker rated momentary current should exceed system capabilities. System capabilities are again determined as in second step, except reactances are those which exist ½ cycle after fault—subtransient reactances of all rotating machines. A multiplier of 1.6 is used to account for circuit asymmetry, but may be reduced to 1.5 where circuit voltage is 5 kv or less and application is at least one transformation from generation.

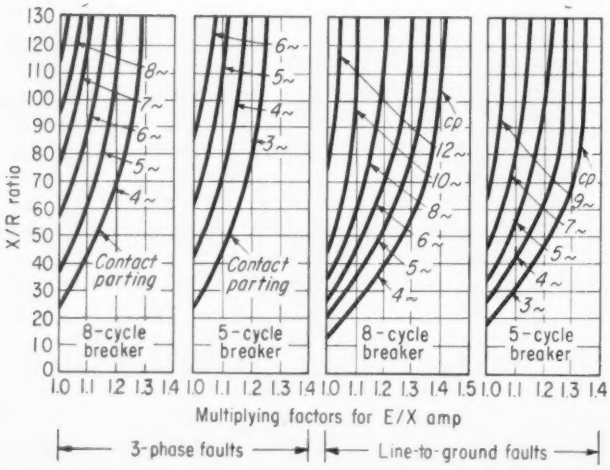
Other factors—standard ratings available and planning for system growth—must, of course, be considered for proper application.

Proposed application practice lets you use any method which accurately determines that interrupting currents, stipulated in the standard and demonstrated in the test code, are not exceeded. As a guide the AIEE proposal suggests you make these checks:

First—breaker *rated maximum voltage* must always be higher than system operating voltage.

Second—breaker *rated short-circuit current* times *rated maximum voltage* divided by operating voltage should exceed system capabilities. Determine these by constructing a reactance diagram and solving for symmetrical short-circuit current E/X at point of application

Multiplier curves give greater accuracy



Procedure known as the "E/X method corrected for ac and dc decrements" has been developed by the AIEE (and included in the proposed *Application guide for alternating-current power circuit breakers,* ASA C37.10) as alternative to simple E/X method and complicated "rigorous" method. Object: high accuracy in determining system requirements with relatively little effort.

In this method, system symmetrical short-circuit current is determined as before. System X/R is found to be over 15, calling for some multiplier greater than 1.00. Multiplier can be read directly from these curves on basis of X/R and contact parting time. Curves are identified as to time in cycles after initiation of fault current.

As more data on X/R ratios is published, this method will provide such a convenient approach to determining system requirements that it should be accepted widely, although simplified E/X method will handle most cases.

Average transformer X/R data

Reactance

Transformer primary kv	Reactance, %
13.2	5.5
27.6	6.0
46	6.5
69	7.0
115	8.0
138	8.5

Resistance

3-phase full-load kva	Resistance, %
500	1.10
1000	0.95
3000	0.80
5000	0.70
10,000	0.60
20,000	0.55

ASA Ratings
Indoor Oilless Power Circuit Breaker

Voltage Ratings			Insulation Level		Current Ratings in Amperes			Interrupting Ratings			
			Withstand test			Short time					
Rated	Max design	Min kv for rated interrupting	Low freq rms	Impulse crest	Continuous 60 cycle	Momentary	4 second	3 phase rated	Amps at rated voltage	Max amperes	Time in cycles
Kv	Kv	Mva	Kv	Kv				Mva			
4.16	4.76	3.85	19	60	1200	60000	37500	250	35000	37500	8
13.8	15.0	11.5	36	95	1200	40000	25000	500	21000	25000	8

Proposed ASA Ratings
Indoor Oilless Power Circuit Breaker

Identification		Rated Values							Derived Values		
		Voltage Rating		Insulation Level		Current Ratings		Interrupting time	Rated max voltage divided by K	Current Values Amperes	
Nominal 3 phase mva	Nominal voltage	Rated max voltage	Voltage range factor	Rated withstand voltage		Continuous 60 cycle	Rated short circuit current at max voltage amp			Max symm interrupting ability & carrying ability for (X) seconds	Closing & latching ability 1.6 x K x rated short circuit current
				Low freq rms	Impulse crest					K x rated short circuit current	
	Kv	Kv	K	Kv	Kv			Cycles	Kv		
250	4.16	4.76	1.24	19	60	1200	30500	8	3.85	37500	60000
500	13.8	15.0	1.30	36	95	1200	19200	8	11.5	25000	40000

ASA RATINGS for some typical indoor oilless (air magnetic) power circuit breakers are compared, present and proposed. This type is normally used in industrial plants

—procedure is identical with previous one except your answer is in amperes. This current is then adjusted by multipliers: 1.25 for industrial systems with 100% local generation and 1.00 for systems without local generation.

In addition, where nameplate rating of induction motors provide 30% or more of total connected load, add 5% to symmetrical system requirements.

The 1.25 multiplier for a system with local generation can be reduced to 1.00 where you know system X/R ratio is less than 15. Graphs, left page, give typical X/R ratio information. You can use these ratios as an aid in making a system X/R determination where actual equipment ratios are unknown. Even if X/R ratio exceeds 15, some modification of 1.25 factor is practical, see bottom of left page.

Third—breaker *maximum symmetrical interrupting current*, equal to K times *rated short-circuit current*, should never be exceeded. But this is not a limiting factor unless system operating voltage is less than $1/K$ times *rated maximum voltage.*

Fourth—breaker *rated closing and latching current*, equal to 1.6 times K times *rated short-circuit current*, should exceed system capabilities. Again, you determine them by constructing a ½-cycle reactance diagram and solving for E/X as in present method.

Symmetrical ratings proposed provide for building into the breaker all requirements of usual circuit with an X/R of 15 or less. Effect of minimum contact-parting time is included. Calculated value for circuit and circuit-breaker rating are similar, with similar required characteristics (asymmetrical current, close and latch, etc); no multiplying factors are needed. Only on the larger equipment, not often used in industrial plants, are stipulated X/R ratios exceeded—unless it's built to special requirements.

If you generate or use large synchronous motors, you can make applications with not more than 25% overrating without determining X/R ratios or more accurate application from machine data.

Proposed ASA Standards revisions are contained in three AIEE transactions papers: 60-151—ASA C37.3, *Definitions* and C37.4, *Rating structure*; 60-152—ASA C37.5, *Methods for sinusoidal waves* and C37.9, *Test procedure*; 60-153—ASA C37.10, *Application guide.*

STANDARDS OF THE HYDRAULIC INSTITUTE give users and consultants a ready guide to principles of good pump practice

Remember the confusion resulting from every pump manufacturer having his own set of letter designations? First step in eliminating the problem has now been taken, with . . .

Centrifugal-pump letter dimensions standardized by Hydraulic Institute

For many years tabulated dimensional drawings for centrifugal pumps have used letter designations—but the designations varied between manufacturers. This led to a lot of confusion when comparing two makes of pump for the same job; you had to remember what letter went with what dimension on which pump. With only 26 letters in the alphabet, there was bound to be overlap.

But now the Hydraulic Institute—an association of pump manufacturers—is coming out with a standardized letter designation for important dimensions on each major centrifugal-pump type. Table, right, gives these letter designations for bare pumps, pumps with base and coupling, close-coupled pumps and vertical pumps. Drawings, next three pages, show where letter designations apply to each type of centrifugal pump covered.

Wherever dimensions are repeated — distances between foundation-bolt holes are an example—they carry the same letter designation but with a subscript to

Standard designations cover all important centrifugal-pump dimensions

Letter designation				View	Definitions
Bare	Base and coupling	Close coupled	Vertical centrifugal		
A	HA	—	—	End	Width of base support
B	HB	—	—	Side	Length of base support
—	C	—	—	Side	Length of driver
CP	CP	—	—	Side	Length of pump
—	HC	—	—	Side	Overall length of combined pump and driver when on base
D	HD	—	—	—	Vertical height—bottom of base support to center line of pump
DD	DD	—	—	—	Distance—center line of pump to bottom drain plug
E	HE	—	—	End	Distance from center line of pump to center line of hold-down bolts
F	HF	—	—	Side	Distance from center line to center line of hold-down-bolt holes
G	HG	—	—	—	Thickness of pads o nsupport or height of base plate, depending on location of bolt holes
H	HH	—	—	—	Diameter of hold-down-bolt holes
J	HJ	—	—	End	Width of pads for hold-down bolts
K	HK	—	—	Side	Length of support pad for hold-down bolts
L	HL	—	—	Side	Horizontal distance from suction-nozzle face to center line nearest hold-down-bolt holes
M	M	—	—	Plan or side	Horizontal distance from center line of discharge flange to center line of suction flange
—	HM	—	—	Side	Height of unit—bottom of base to top of driver
N	—	—	—	Side	Distance—end of bearing housing to end of shaft
O	HO	—	—	—	Vertical distance—bottom of support to discharge-nozzle face or top of case on horizontally split pumps
P	HP	—	—	Side	Length from edge of support or base plate to center line of bolt holes
—	—	LP	—	Side	Length of adapter piece
—	—	MP	—	Side	Distance from face of suction flange to mounting flange of adapter
R	HR	—	—	Side	Horizontal distance from center line of discharge flange to center line of hold-down-bolt holes
S	S	—	—	End	Distance from center line of pump to center line of suction nozzle
—	HT	—	—	Side	Horizontal distance between pump and driving shaft
U	—	—	—	—	Diameter of straight-shaft coupling end
V	—	—	—	Side	Length of shaft available for coupling or pulley
—	—	—	VD	—	Vertical height from bottom of base support to center line of discharge nozzle of vertical pumps
—	—	—	VF	Side	Distance from center line of vertical pump to center line of hold-down-bolt holes
—	—	—	VS	—	Vertical distance from center line of discharge nozzle to center line of suction nozzle on vertical pumps
—	—	—	VY	Side	Horizontal distance from center line of pump to face of suction elbow of vertical pumps
W	W	—	—	Side	Distance from center line of discharge flange to end of pump shaft
—	HW	—	—	Side	Distance from center line of discharge flange to end of motor
X	X	—	—	End or side	Distance from discharge face to center line of pump
—	—	XR	—	Side	Distance from center line of motor hold-down bolt to center line of conduit box
Y	Y	—	—	Side	Horizontal distance from center line of discharge nozzle to suction-nozzle face
YY	YY	—	—	End	Horizontal distance from center line of case to suction-nozzle face on horizontally split pumps
Z	Z	—	—	End	Center line of discharge nozzle to center line of pump

Subscripts: Where multiple dimensions for similar components are required—mounting-pad widths and locations, for example—subscripts 1, 2, 3, etc should be used. Number from right to left—HE_1, HE_2 and HE_3

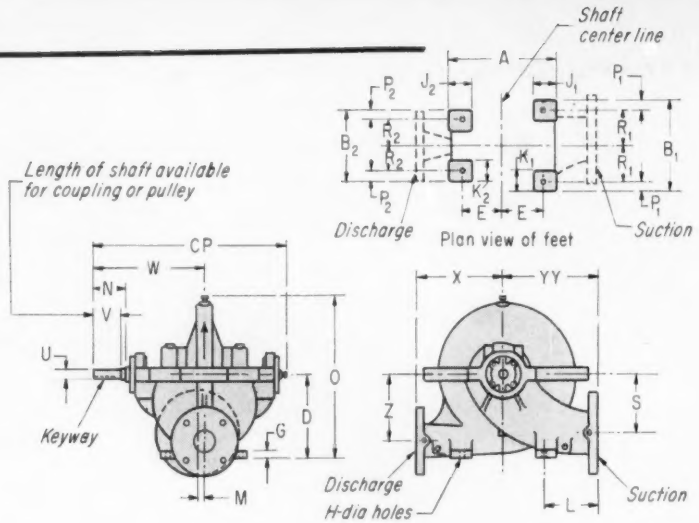
clearly show the specific dimension referred to. Also, for close-coupled pumps, letter designations agree with National Electrical Manufacturers Association (NEMA) Standards. These dimensions are circled on the drawing.

Centrifugal-pump stuffing-box standard letter designations are shown on last page. In addition to the box itself, letters cover seal cage, packing gland and distance to the first obstruction. This data is especially useful to pump maintenance men ordering replacement packing. And when a pump is to be furnished with a mechanical seal, seal manufacturer needs complete dimensional data to insure proper selection and installation.

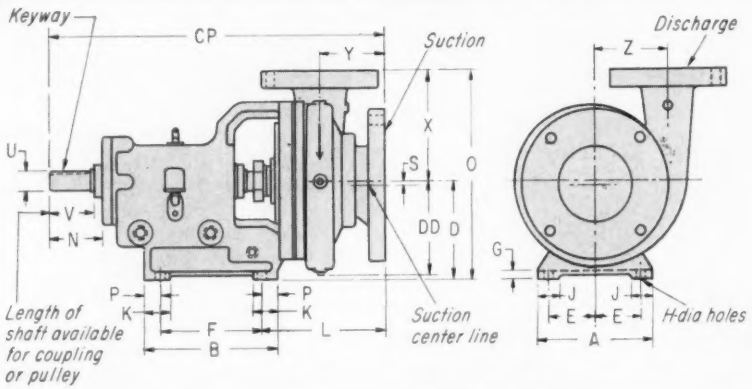
Use of these standards by purchasers and their consultants will reduce confusion when comparing pumps of different manufacture. And when dimensions are to be transmitted from manufacturer to purchaser there can be no mistake. In some cases this will probably eliminate costly errors and misunderstandings.

continued

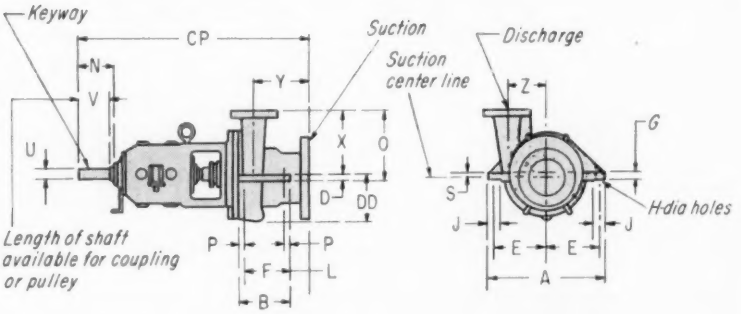
Horizontal split - case double - suction pumps for waterworks and general service



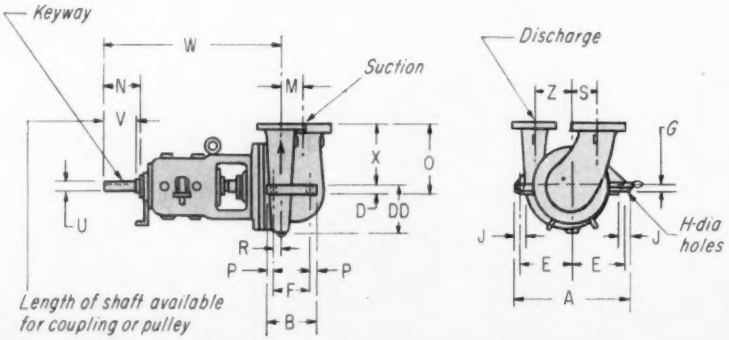
End - suction overhung impeller pumps for general service and many process applications

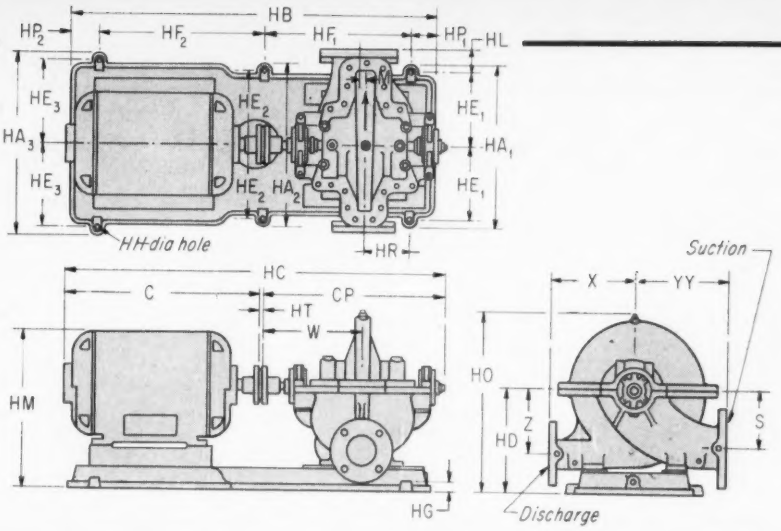


Process type pumps with center-line support for high - temperature liquid handling

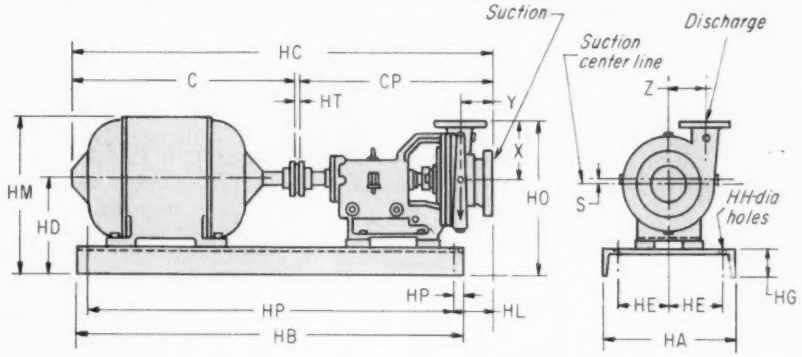


Process type pumps with top - suction connection for ease in setting up piping

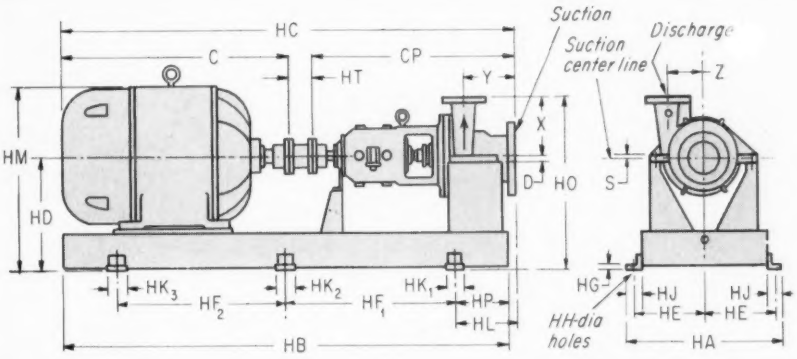




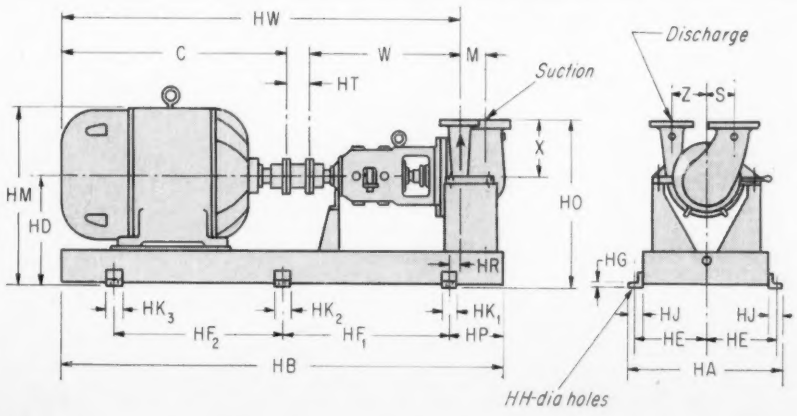
Double-suction impeller in this pump design gives good suction characteristics and high efficiency—basis of its extensive use in waterworks. Rated speeds usually match full - load induction - motor speeds but can be varied to meet engine or geared-turbine speeds. Sleeve or roller bearings are common, using either grease or oil.



End-suction overhung-impeller pumps are available in both medium- and heavy-duty designs. Closed, semi-open and open impellers meet special pumping needs of slurries as well as clear liquids. Ball or roller bearings with either grease or oil lubrication can be specified to meet owner's preferences.



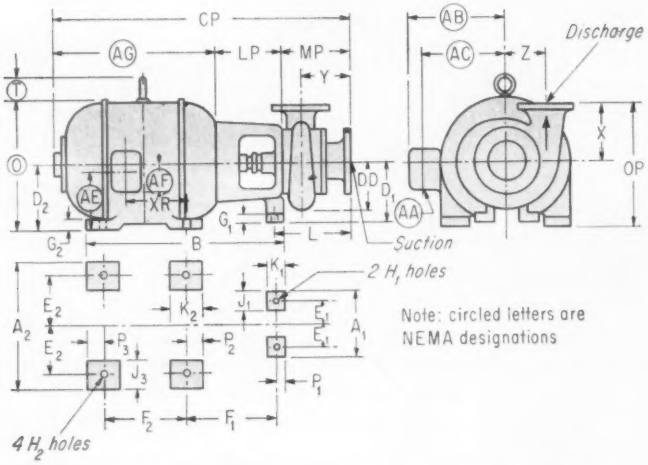
High-temperature service requires center-line support to keep reasonable alignment hot and cold. Then only radial expansion is possible so pump's center line doesn't rise or fall with temperature. Alignment is important in spite of flexible coupling used between pump and driver. Water jackets cool bearings and stuffing boxes.

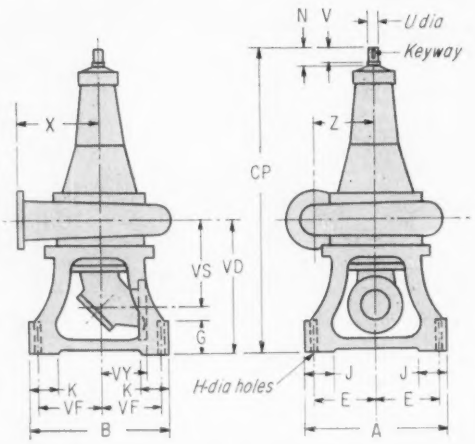


To ease piping problems, high-temperature pumps often have top-suction connections. Then pump can be placed directly under vessel from which it takes its suction, minimizing pipe losses and keeping available npsh as high as possible. Feature involves suction-head design only.

Turn page →

Close-coupled pumps see general use; vertical dry-pit types handle waste disposal

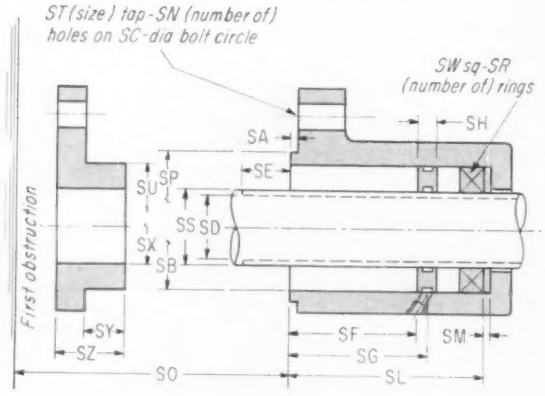




Close-coupled pumps eliminate need for driver-pump alignment—saving maintenance headaches—since pump and motor are on the same shaft. There are no separate pump bearings to lubricate. But there is also no interchangeability of motors unless you have a good many pumps of this type in your plant. Pump materials range widely to meet almost any need, and open, semi-open and closed impeller designs are available to handle difficult liquids.

Vertical pumps are widely used in sewage and other waste-disposal applications. In larger sizes their use broadens out into a variety of fields. Vertical dry-pit arrangement permits head on suction, eliminating priming equipment. Motor drivers can be independently mounted or supported directly on the pump itself.

Stuffing-box-dimension standards help you apply packing and mechanical seals



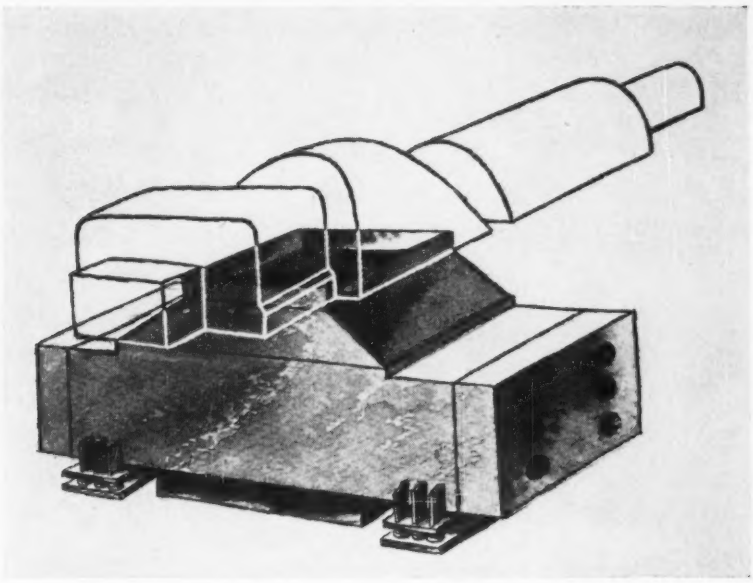
Letter designation	Definition
SS	Outside diameter of shaft sleeve or diameter of shaft if no sleeve is used
SD*	Diameter of shaft under sleeve if sleeve is used
SB	Inside diameter of stuffing box
SL	Effective length of stuffing box
SP	Outside diameter of pilot register on face of stuffing box
SA	Depth of pilot register on face of stuffing box
SF	Distance from face of stuffing box to center line of tapped hole for lubrication or coolant fitting outside stuffing box
ST	Size tap and type thread for gland studs or bolts
SN	Number of tapped holes for gland studs or bolts
SC	Diameter of bolt circle for gland studs or bolts
SG	Distance from face of stuffing box to center line of tapped hole for lubrication or coolant fitting inside stuffing box
SH	Thickness of seal cage
SM	Thickness of stuffing-box bushing
SE*	Distance from face of stuffing box to end of shaft sleeve
SW	Size of packing
SR	Number of packing rings
SU	Outside diameter of insertable portion of gland
SX	Inside diameter of gland
SY	Length of insertable portion of gland
SZ	Overall length of gland
SO	Distance from face of stuffing box to first obstruction

*Applicable only when shaft sleeve is used

Standards of the Hydraulic Institute

These standards cover centrifugal, rotary and reciprocating pumps. Within each classification are sections covering nomenclature, hydraulic calculations, test methods and installation and operating data. Copies may be purchased from the Hydraulic Institute, 122 East 42nd St, New York 17, N. Y. at $6.00 per copy, $6.50 foreign.

By JOHN S FERGUSON
Thermal Power Supt
Heat Transfer and
Water Conditioning Products
Allis-Chalmers Mfg Company



1 Crosswise settings of condenser, or one parallel to turbine shaft, are most often used for ratings from 20 to 325 mw. Largest unit has 200,000-sq-ft total surface

Modern condensers shape plant design

Despite their bulk, condensers can be placed to achieve best overall plant layout. They must work with low temperature differential and pressure drops to maintain efficiency

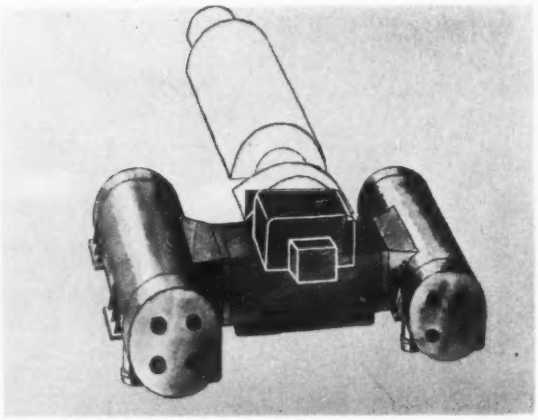
Surface-condenser design and placement have been evolving to meet the newer multi-exhaust needs of large modern turbine-generator units. Downward-exhaust arrangements have dominated turbine design practice for many years, but now some units are being built with side and axial exhausts. Only time will show whether the newer axial- and side-exhaust machines find general acceptance for our power plants.

Fig. 1 shows a conventional condenser placement under a turbine. The crosswise setting (perpendicular to turbine shaft) is preferred because it needs less basement height. With a parallel setting for a small-sized turbine—7500 kw and below—oil tanks and other auxiliaries may interfere with the condenser and require a larger basement height under the unit.

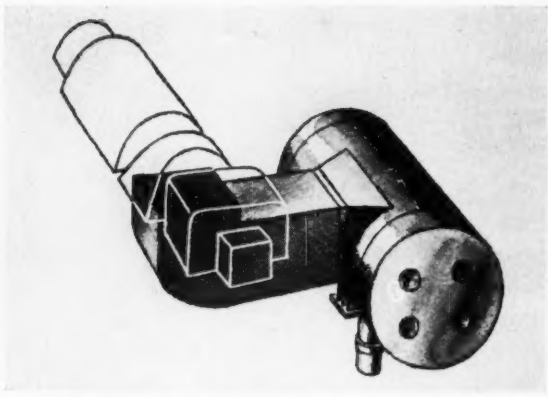
Condenser width limitations are governed by the distance between turbine foundation columns. Space between columns usually is greater crosswise than parallel to turbine shaft and so allows a shallower condenser installation. Generally the longest turbine-exhaust-nozzle dimension stands in the crosswise direction, permitting a shorter condenser neck than a parallel setting would need for comparable steam distribution.

Rectangular condenser shells, the present trend, utilize space much better than do other shapes in a crowded plant. A rectangular unit will require less basement height than a round or oval condenser. In the past, cylindrical units were most prevalent, although the first condenser built by Allis-Chalmers Manufacturing Company in 1880 was rectangular in outline.

Mounting the condenser off to the



2 Medium to small condensers at sides are used by 20- to 150-mw turbines. Most are round; usual service is out-of-doors



3 Side placement may be limited to single shell instead of two. Scheme reduces turbine foundation height in earthquake areas

Turbine needs decide condenser arrangement

side of the turbine, Fig. 2 and 3, can reduce basement height for the station anywhere from 25 to 40%. This layout needs fairly long transition or connecting pieces between turbine exhaust and condenser steam inlet. To keep steam-pressure drop low in the transition piece, the design must be carefully laid out in respect to aerodynamic flow of the exhaust steam.

Outdoor power plants use the side arrangement to reduce turbine foundation height, achieve important plant-investment savings. And in areas subject to earthquakes, this arrangement in the power plants will minimize possible equipment damage.

Multiple-nozzle turbines have increased their percentage of total units built during the last 12 years. This challenges condenser designers to find the best placement for condensers under these units, Fig. 4, 5, 6.

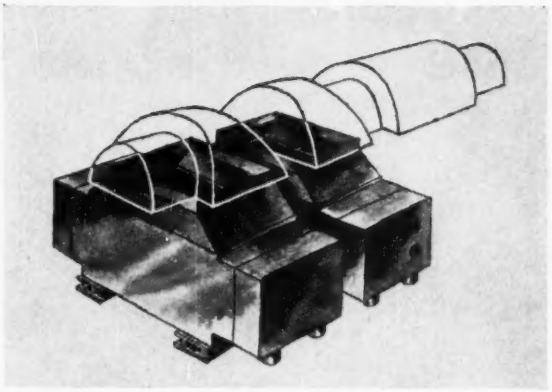
When the exhausts are on the same shaft, a crosswise setting using two condensers, Fig. 4, or a parallel setting using one condenser with two separate necks, Fig. 5, could work out. With the exhausts on separate shafts, two condensers as in Fig. 4 could be used, but they would be installed parallel to the turbine shafts. The unit in Fig. 6 could also be used with this type of turbine.

Axial-exhaust turbines dictate side-inlet condensers. Fig. 7 shows an arrangement reducing basement height to an absolute minimum. The condenser stands crosswise to the turbine with its bulk above the turbine operating floor.

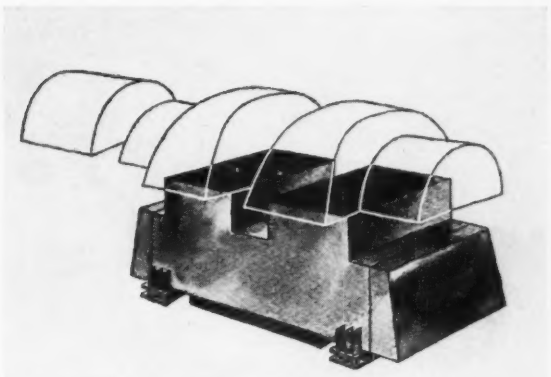
Sometimes condensers have been designed as part of the turbine foundation. This design has been limited to units rated 20 to 100 mw and sees extensive service with marine-propulsion turbines, Fig. 8.

When you're modernizing a plant by removing several small, old turbine-generators to be replaced by a single larger unit, the problem of available basement height becomes critical. If turbine operating-floor height can be raised through only a limited range, the condenser may be placed on the floor as in Fig. 9.

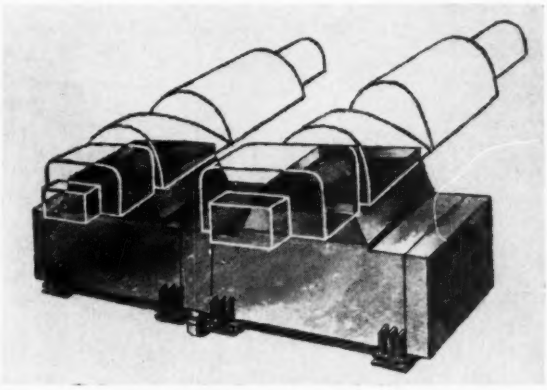
These arrangements represent more-common installations of recent years; there have been many peculiar installations in the past and undoubtedly will be more in the future. Turbine designs of tomorrow will largely determine most-prevalent condenser arrangements inside the plant.



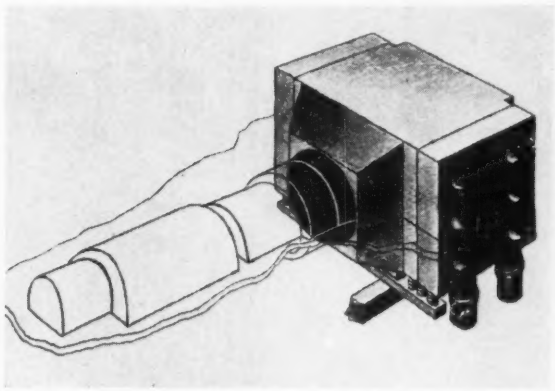
4 Two crosswise condensers in parallel are often used for 250- to 450-mw units; condensing surface may exceed 200,000 sq ft



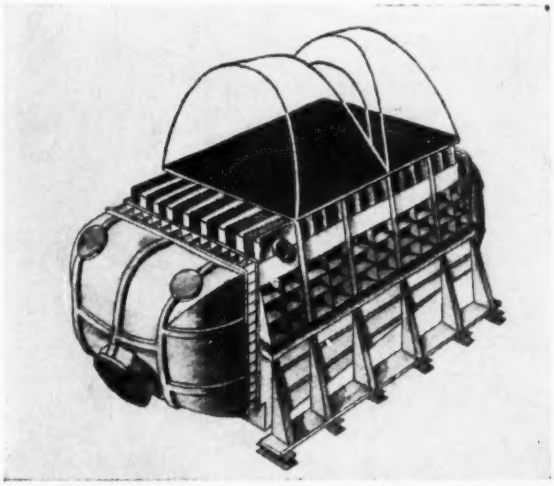
5 Practical arrangement of double-inlet shell may take 50-ft tubes and longer, could be used for 150- to 450-mw units



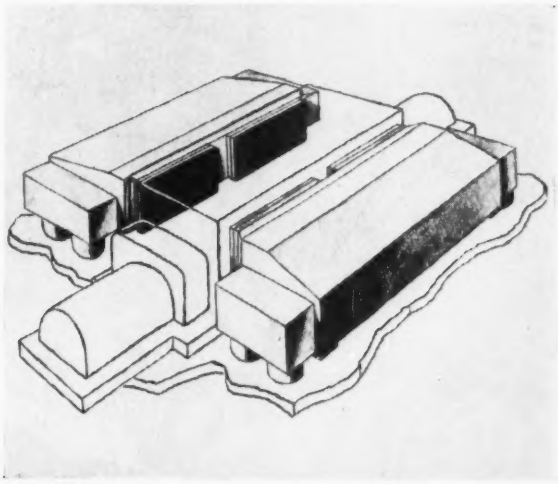
6 Should long tubes not be feasible, two condenser shells can be placed end to end. Arrangement handles 250 to 450 mw



7 Placing condenser shell opposite turbine's center line greatly reduces basement height—good for 150- to 350-mw units



8 Common marine practice of supporting turbines on condenser foundation has been used on some land units, 20 to 100 mw



9 Side-mounted condensers on 150- to 400-mw turbines solve problem of limited basement height in modernized stations

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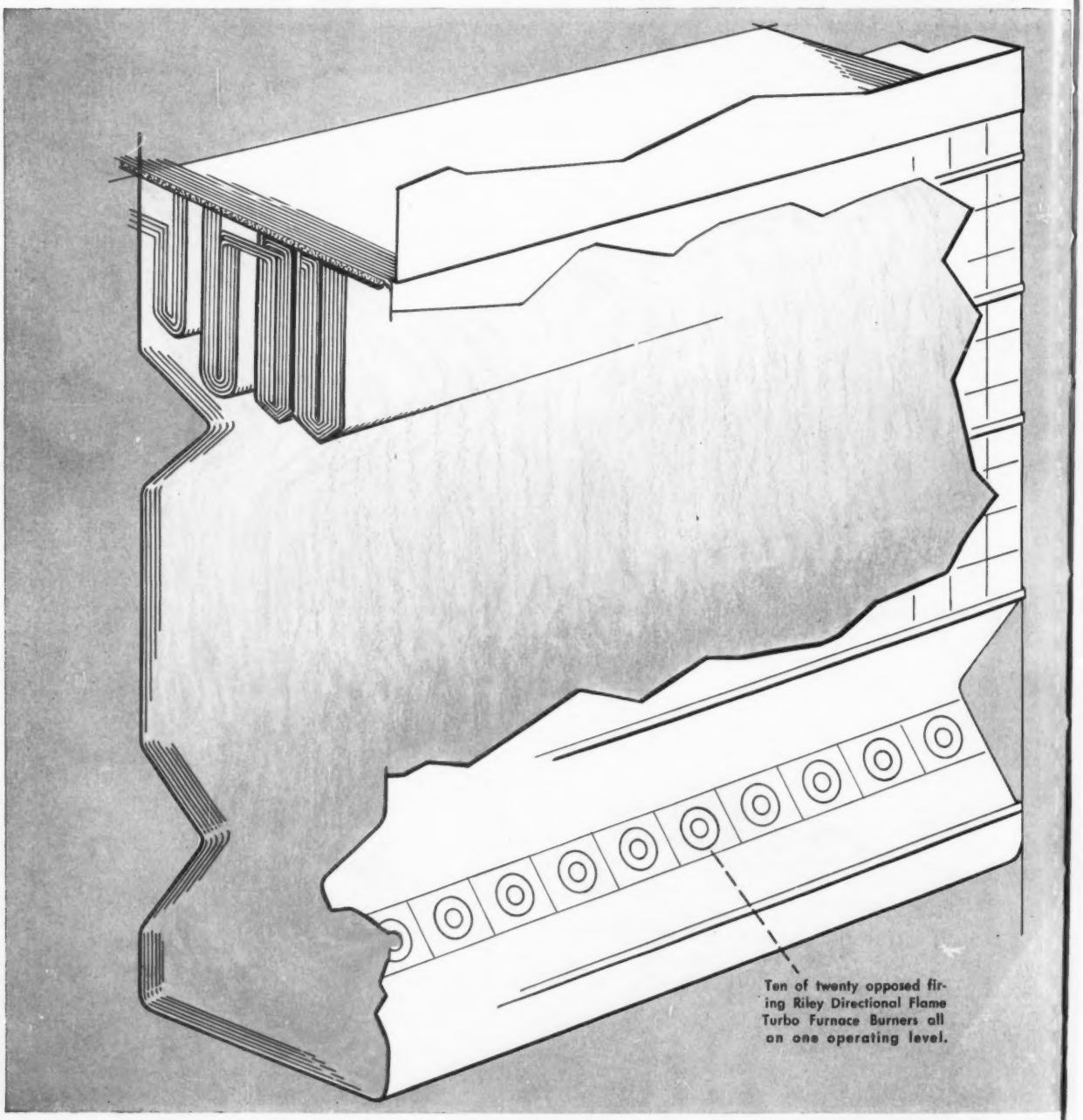

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The advanced design of the TURBO FURNACE represents an important step forward toward more efficient boiler operation. Because any available fuel can be burned at any time without major alterations the TURBO FURNACE boiler is the ideal "Convertible" furnace for today's and tomorrow's fuel economics.

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Some Typical Riley Turbo Furnace Boiler Installations.

Delaware Power & Light Co.
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3 Units — 500,000 lbs/hr each
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Texas Electric Service Co.
Permian Basin Steam Elec. Station
1 Unit — 825,000 lbs/hr
1750 psig — 1005/1005F
Fuels — Gas, Oil, Future Coal

Dallas Power & Light Co.
Northlake Steam Elec. Station
2 Units — 1,200,000 lbs/hr each
2125 psig — 1005/1005F
Fuels — Gas, Oil, Future Coal

Louisiana Power & Light Co.
Sterlington Steam Elec. Station
1,550,000 lbs/hr
2125 psig — 1005/1005F
Fuels — Gas, Future Oil, Coal

Louisiana Power & Light Co.
Little Gypsy Steam Elec. Station
1,650,000 lbs/hr
2125 psig — 1005/1005F
Fuels — Gas, Oil

Florida Power Corporation
Turner — Unit No. 4
600,000 lbs/hr
1750 psig — 1000/1000F
Fuels — Gas, Oil

New Orleans Public Service Co.
Michoud — Unit No. 3
1,550,000 lbs/hr
2325 psig — 1005/1005F
Fuels — Gas, Oil, Future Coal

Manila Electric Co.
Rockwell Station — Units 6, 7
430,000 lbs/hr each
2160 psig — 1005/1005F
Fuel — Oil

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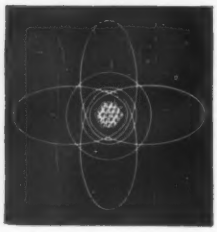

Nuclear notes

By B G A SKROTZKI, Associate Editor

Yankee Atomic Electric plant at Rowe, Mass. began generating power on a test basis at 2:30 am on November 10, 1960. The 136-mwe plant went critical on August 19, 1960. Owners hoped the plant would have produced 100 mwe before the end of 1960. This is Westinghouse Electric's largest nuclear plant built to date.

Improved-cycle boiling-water reactor (ICBWR) proposal by Allis-Chalmers has been accepted by AEC as a basis for contract negotiations. The 50-mwe plant will be built in Haskell Canyon of Los Angeles County, Calif. Los Angeles and Pasadena will provide the turbine-generator facilities and the site and run the plant for not less then five years. They will buy the reactor steam from the AEC. Proposal has Allis-Chalmers design, build and test-operate the reactor, furnish the first core and spare fuel elements and train the operating personnel. Plant is scheduled to start running in early '64.

World's largest atomic plant will be built on Britain's east coast at Sizewell in Suffolk. The 580-mwe plant will have two gas-cooled graphite-moderated reactors of improved Calder Hall type supplying steam to two 350-mw turbines. Plant will be built by the English Electric, Babcock & Wilcox, Taylor Woodrow Atomic Power Group. Construction starts April 1961 and operation is scheduled for 1966. The plant will bring Britain's nuclear capacity to 3000 mw, more than 10% of its total generating capacity.

"Coated-particle" nuclear fuel will be researched by Battelle Memorial Institute for the AEC. This fuel should have high-temperature resistance, fission-product retention and good neutron economy. Grains of fissionable nuclear fuel, about the size of table salt, will be coated individually with a dense refractory material for protection from chemical reaction at high temperatures and to prevent escape of fission products. Both carbon and alumina coatings have worked well in early tests for the pebble-bed reactor. Coated particles will be distributed evenly into graphite that can be shaped into convenient fuel elements. Interested manufacturers should contact Dr R W Dayton at Battelle Memorial Institute for more information on this program.

Gas-cooled reactor experiment at AEC's National Reactor Testing Station in Idaho ran with a second core at design rating of 2 mwt on Nov 23, 1960. The smaller and lighter core allows running the prototype mobile plant ML-1 at 300 to 500 kwe for a full year. This plant can be moved by tractor-trailer, air or rail in four packages totaling 38 tons. It can develop full output 12 hr after reaching its destination and can be moved 24 hr after shutdown.

Nuclear forecast by The Europen Nuclear Energy Agency (ENEA) predicts about 6000 mwe running on the Continent by 1966—about 3% of total capacity. These 6000 mwe would supply about 5% of the total kwhr. Capital investment might run about $2.2 billion; fuel costs through 1966 will be about $700 million for 15,000 tons of natural uranium and $174 million for 600 tons of enriched uranium. About 5000 mwe of the plants will be fueled by natural uranium bought in Europe. The enriched fuel for 1000-mwe capacity will be bought from the U.S.A. By 1975 ENEA expects nuclear capacity may range between 12,000 and 35,000 mwe, from 3 to 9% of total capacity. Capital costs for natural-U plants are estimated at $280 per kwe, boiling-water reactors at $250 per kwe. (*McGraw-Hill World News*)

WESTINGHOUSE improves new transformers 5 ways with aid of REVERE ROLLED COPPER in coil winding

New design extends range of lightweight pole-type transformers to 500 Kva

In seeking to solve the problem of cross-sectional requirements in the winding of conductors in low-voltage coils of large Distribution Transformers, Westinghouse design engineers noted that their primary concern was: How to reduce the number of individual conductors in the low-voltage windings.

The final design is one which uses a sheet of copper across the width of the low-voltage coil so that one turn becomes one layer. The thickness of the sheet is varied to give the required sectional areas (see photo lower left).

Westinghouse engineers, in collaboration with Revere and other suppliers, wrestled with the problem of securing a satisfactory sheet material for this purpose for over a year. The layer insulation was designed to be sufficient for turn-to-turn insulation; this eliminated, from an electrical standpoint, the need for insulated sheet copper. However, this method presented still another problem. For, to accomplish this, the copper sheet had to be sufficiently burr free to permit the use of a single sheet of thin layer insulation. The answer to this problem was the development of a smooth Revere Rolled Copper sheet, which contributed to giving the new Westinghouse sheet-wound copper design transformer the following outstanding advantages:

1. A compact coil of great inherent mechanical strength against short circuit forces.

2. Reduction in losses and impedance by reducing the high-low space to a minimum.

3. Weight reduction directly through reduced mean turn and indirectly by eliminating coil bracing.

4. More effective cooling obtained by removing coil blocks and braces.

5. Total lower weight of unit which permitted extension of pole mountings to ratings which were previously available only in the substation type.

Find out today how Revere Rolled Copper can be used to advantage in your coil winding application.

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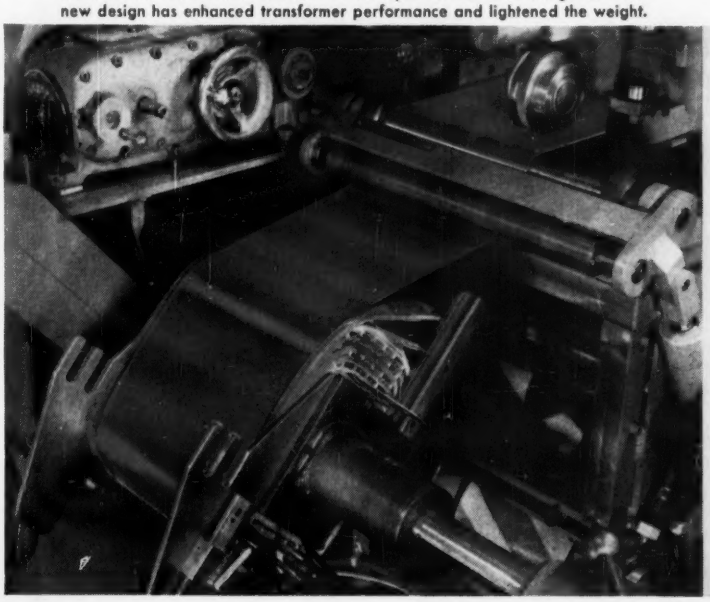
PACE-SETTING sheet-wound coil design uses a sheet of copper across the width of the coil so that one turn is one layer of the Low-voltage coil. The new design has enhanced transformer performance and lightened the weight.



ONE OF THE WESTINGHOUSE transformers—a 500 Kva, 7200 Volt rating—incorporating the new design. Previously available only in the substation type.

Reserved for your comment

BOB BELLAS, Associate Editor

EDITOR'S NOTE: *We knew much of the information in our December 48-page staff report,* Air Pollution, *would be of immediate help to many who are not regular readers of* POWER. (*see* Speaking of POWER, *p 2*). *Thus, as a public service, we mailed reprints of the report to Members of Congress, Governors, Mayors of large cities and key air-pollution officials. Following are some comments received to date.*

U.S. Senate

I have long been concerned with the growing air-pollution problem in Phoenix and I have done quite a bit of air research of my own trying to prove that part of our problem stems from smelters, but I have been dueling with a windmill. To me air pollution is one of the most serious problems confronting us in the coming years, and I am grateful to you for recognizing it in your magazine.

BARRY GOLDWATER, *Arizona*

. . . This is indeed a very serious problem and I am pleased to have this report as a reference in my study of it.

HUBERT H HUMPHREY, *Minnesota*

. . . I greatly appreciate receiving this additional information on this vital and serious matter, and I certainly feel that additional study and research is necessary in order that we may better understand the effects of air pollution on human physiology and efficiency.

STYLES BRIDGES, *New Hampshire*

House of Representatives

I appreciate having this valuable reference material for our files, particularly since this matter is under study by the Interstate and Foreign Commerce Committee of which I am a member.

I look forward to giving this report a careful study, but in glancing through it I was certainly impressed with the clear and graphic manner in which the material is presented.

ANCHER NELSEN, *2nd District, Minnesota*

. . . I will read the report on air pollution with a great deal of interest and I appreciate your thoughtfulness in making a copy of this article available to me.

THOMAS N DOWNING, *1st District, Virginia*

. . . I have started reading the report on air pollution you so kindly sent. It is very fascinating and informative.

ROBERT R BARRY, *27th District, New York*

. . . Air pollution is a very serious problem in many of our industrial areas and in briefly reviewing the article, I have found it extremely interesting. I wish to compliment you and your associates for this fine presentation.

CLIFFORD G MCINTIRE, *3rd District, Maine*

State governors

I am going to take this magazine home with me so that I can study the report carefully.

S ERNEST VANDIVER, *State of Georgia*

. . . Since this is a matter which comes under the jurisdiction of the State Department of Public Health, I have transmitted your letter to Dr Malcolm Merrill, Director of that Department, with a request that he reply directly to you.

EDMUND G BROWN, *State of California*

. . . Governor Rockefeller has asked me to thank you for your letter of November 28 and for your thoughtfulness in sending him a copy of the Air Pollution Report from the Dec issue of POWER.

This is a subject in which the Governor is very much interested and in order that they also may have the benefit of this report he has asked me to forward it to the Air Pollution Control Board.

WILLIAM J RONAN,
Secretary to the Governor
State of New York

. . . This is most interesting and I am referring it to the Chairman of our Air Pollution Committee, Mr Jess Hawley Jr, so that he may also read it.

ROBERT E SMYLIE, *State of Idaho*

. . . This special report is certainly most timely and is extremely well prepared. Your staff is to be complimented for its work in preparing the report. I am sure the report will be of much value to those in state government who are concerned about the problem of air pollution. I am taking the liberty of forwarding your report to the proper state officials in the areas of Health and Resources who are the most interested in this subject.

STEVE MCNICHOLS, *State of Colorado*

. . . I am referring this to Dr R H Hutcheson, Commissioner, Tennessee Department of Public Health, who I am sure will make it available to the medical and engineering staff of our Industrial Health and Air Pollution Control Sections.

BUFORD ELLINGTON, *State of Tennessee*

. . . I am sure this report will be of great benefit

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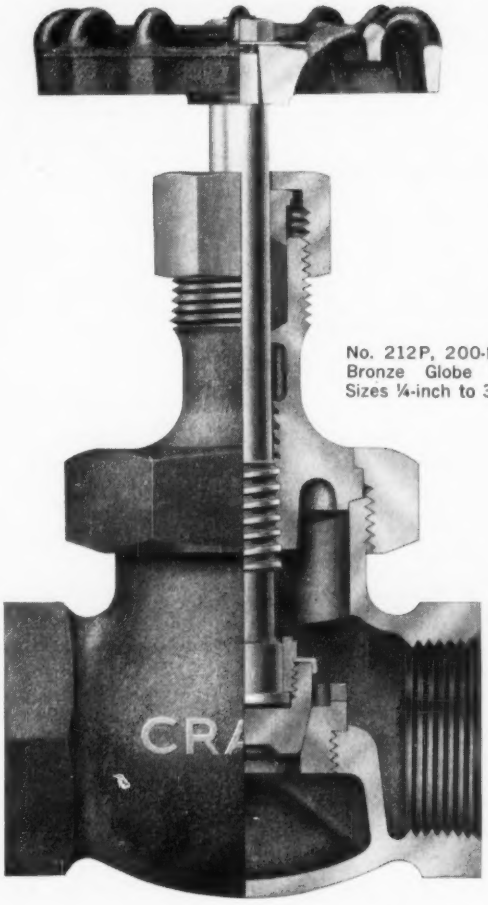

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For more facts circle 235 on Reader Service card, p 99

to many communities which are experiencing this pollution problem.

J HOWARD EDMONDSON, *State of Oklahoma*

. . . I will pass this along to the proper committees when I take office on January 18. In the meantime I expect to peruse the important contents with a great deal of interest.

ELBERT N CARVEL, *Governor Elect*
State of Delaware

Air-pollution officials

Preventive programs to maintain clean air are far less costly than the corrective programs made necessary by areas led to believe they can't afford clean air.

In reality, America can't afford not to have clean air, and your factual analysis of the problem and its solution is the only commendable manner in which it can be brought to public attention.

My best to you for your forthrightness.

JOHN H FAIRWEATHER
Air Pollution Control Officer
San Bernardino, Calif.

. . . I found it very interesting, and have sent it around to members of my staff who are especially interested in this problem.

C G SALSBURY, *MD, Commissioner*
Arizona State Department of Health

. . . Several of the items in it will be considered when we appoint new members to the Air Pollution Control Board of Appeals.

ROSS V DOUGHTY, *Combustion Engineer*
City of Dayton, Ohio

. . . The very timely information contained in this report will be reviewed with considerable interest by members of our air-pollution control staff.

J B ASKEW, *MD, Director of Public Health*
County of San Diego, Calif.

. . . I feel that you have done an excellent job in this special report, and I expect it will be very helpful to air-pollution officials in bringing to the attention of your subscribers an overall account of this serious problem. It is particularly valuable since so many of your subscribers are plant engineers and, therefore, are in the position to do something about controlling air pollution.

Congratulations on a fine job.

LEO P FLOOD, *Chief Engineer*
Dept of Air Pollution Control
City of New York, N. Y.

. . . I have not had time to give this the study it deserves but have gone into it thoroughly enough to realize it could serve as a complete elementary textbook on the subject. It will be a valued addition to our library.

J H CARTER, *Commissioner, Smoke Regulation*
City of St. Louis, Mo.

. . . My associates and I agree that it constitutes a useful brief summary of the air-pollution picture. It is desired to distribute the report to our district offices.

JAMES L DALLAS,
Air Pollution-Radiological Health Section
Massachusetts Dept of Public Health

Municipal executives

We were very much interested in the Air Pollution Report appearing in the December issue of your publication. . . . I have asked the Director of Chicago's Department of Air Pollution Control, Mr Thomas H Carey, to read it also.

RICHARD J DALEY, *Mayor, City of Chicago, Ill.*

. . . Air pollution is a community problem which we presently have under study. The material in your magazine is well presented and I am sure it will be very helpful to us.

DICK BATTERTON, *Mayor*
City and County of Denver, Colo.

. . . It is reassuring to me that this material, involving current research, has been made available in a scholarly and meticulous publication such as yours.

CHARLES C DAIL, *Mayor, City of San Diego, Calif.*

. . . The article is complete and yet simple enough for the average person to understand. I enjoyed it.

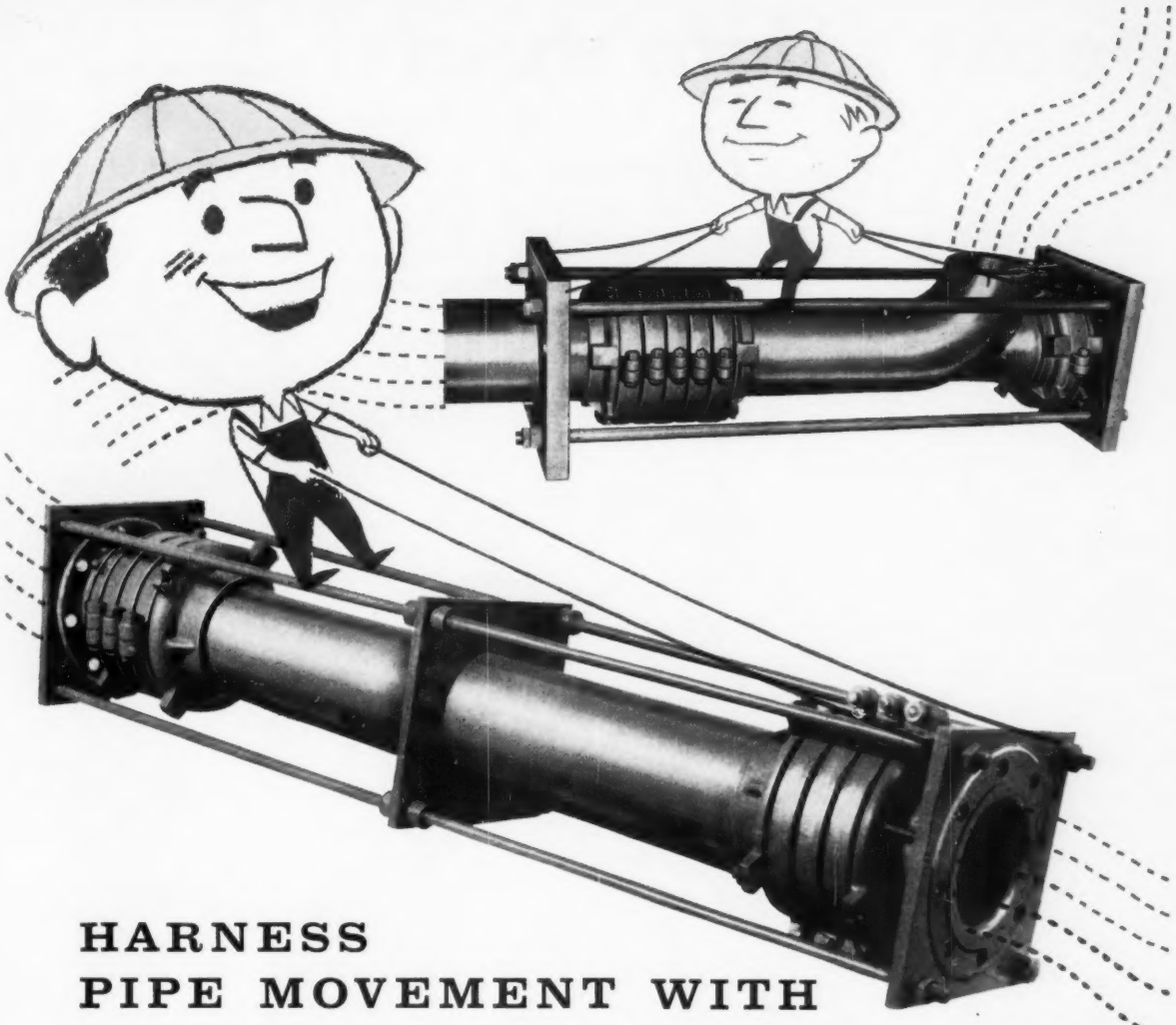
RAY G WOODS, *Chairman, Board of City Directors*
City of Pasadena, Calif.

. . . The special report, *Air Pollution*, in the Dec 1960 issue of POWER is a wonderful job.

Our City Council is considering a smoke-abatement ordinance. I am much interested in getting ten reprints of the article or ten copies of this issue of POWER for distribution to our seven councilmen, mayor, safety-service director and city engineer for study *before* we take action on a piece of legislation which needs thorough consideration.

JOSEPH W DAVIS, *Councilman, Findlay, Ohio*

Reprints of the 48-page report, Air Pollution, *are available from* POWER, *Reader Service Dept, 330 W 42nd St, New York 36, N. Y., for $1.00 a single copy. Discounts: 10%, 25%, 40% on orders of 10, 100, 1000 copies.*



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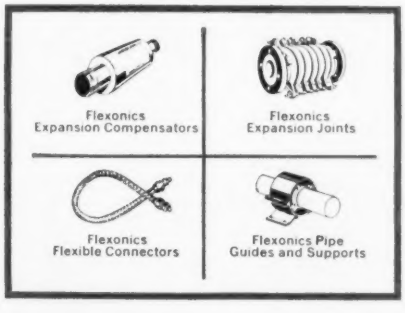

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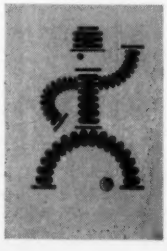

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For more facts circle 236 on Reader Service card, p 99

Power's data sheet

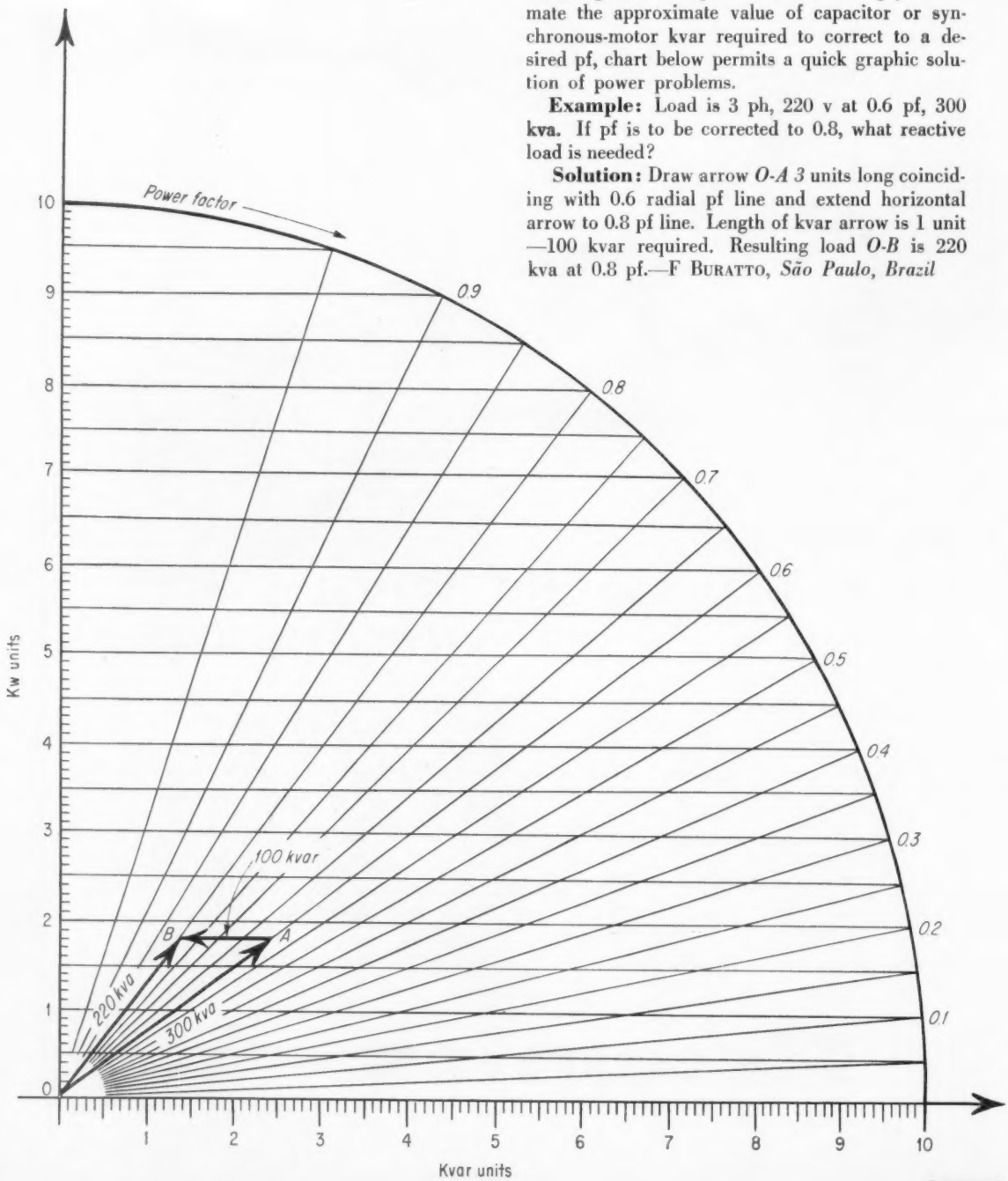
No. 341

Calculate kvar required to correct power factor

A major problem in many industrial plants arises from low power factor for individual equipment or overall system loads. Normally, pf is corrected by installing reactive capacitive load. To help you estimate the approximate value of capacitor or synchronous-motor kvar required to correct to a desired pf, chart below permits a quick graphic solution of power problems.

Example: Load is 3 ph, 220 v at 0.6 pf, 300 kva. If pf is to be corrected to 0.8, what reactive load is needed?

Solution: Draw arrow *O-A 3* units long coinciding with 0.6 radial pf line and extend horizontal arrow to 0.8 pf line. Length of kvar arrow is 1 unit —100 kvar required. Resulting load *O-B* is 220 kva at 0.8 pf.—F Buratto, *São Paulo, Brazil*



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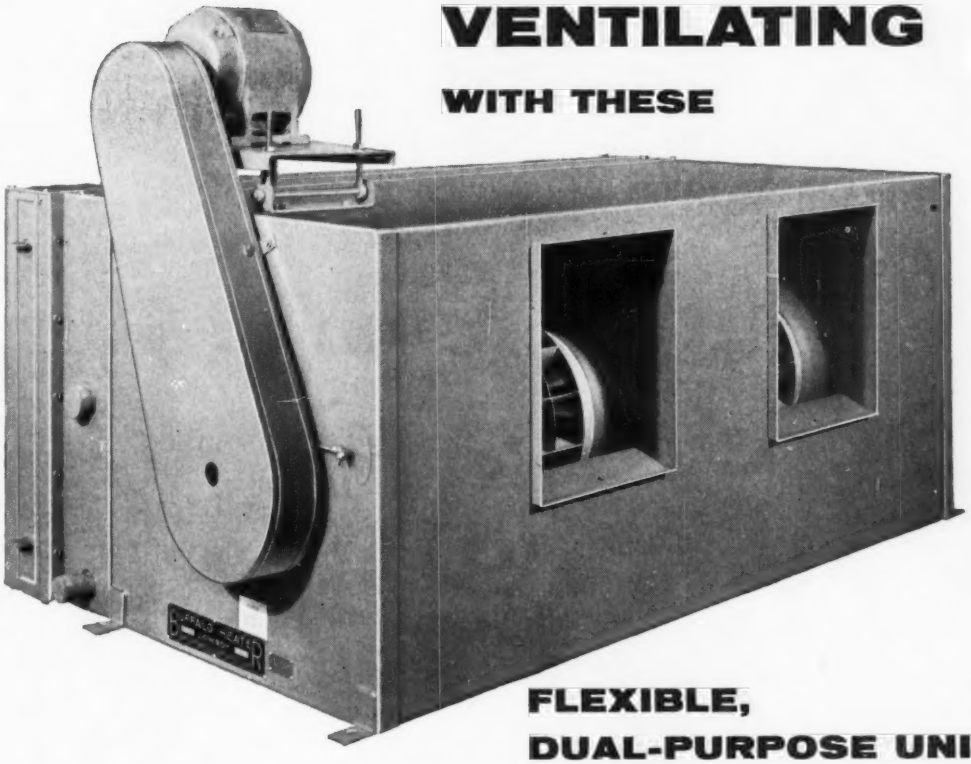
PLAN YOUR HEATING AND VENTILATING WITH THESE



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And *Buffalo* Units offer you these *extra* advantages:

Sectionalized Cabinet — easy to assemble, easy to install and easy to service — includes fan section, coil and base section of welded heavy gauge construction. Available with ½" spray-coated fiberglass insulation inside.

High-Performance Fans — streamlined housings, oversize hollow shafts and mixed flow wheels for stability and efficient distribution at low velocities.

Efficient heating coils — Aerofin Type BNF non-freeze for steam heating to 200 psig and 400°F.; Type H for hot water heating.

Choose any combination — Type HV for horizontal or vertical operation, both heating and ventilating; Type V for ventilating only; choice of filter boxes, mixing boxes, dampers; 45° or 90° outlet elbows, swivel or stationary.

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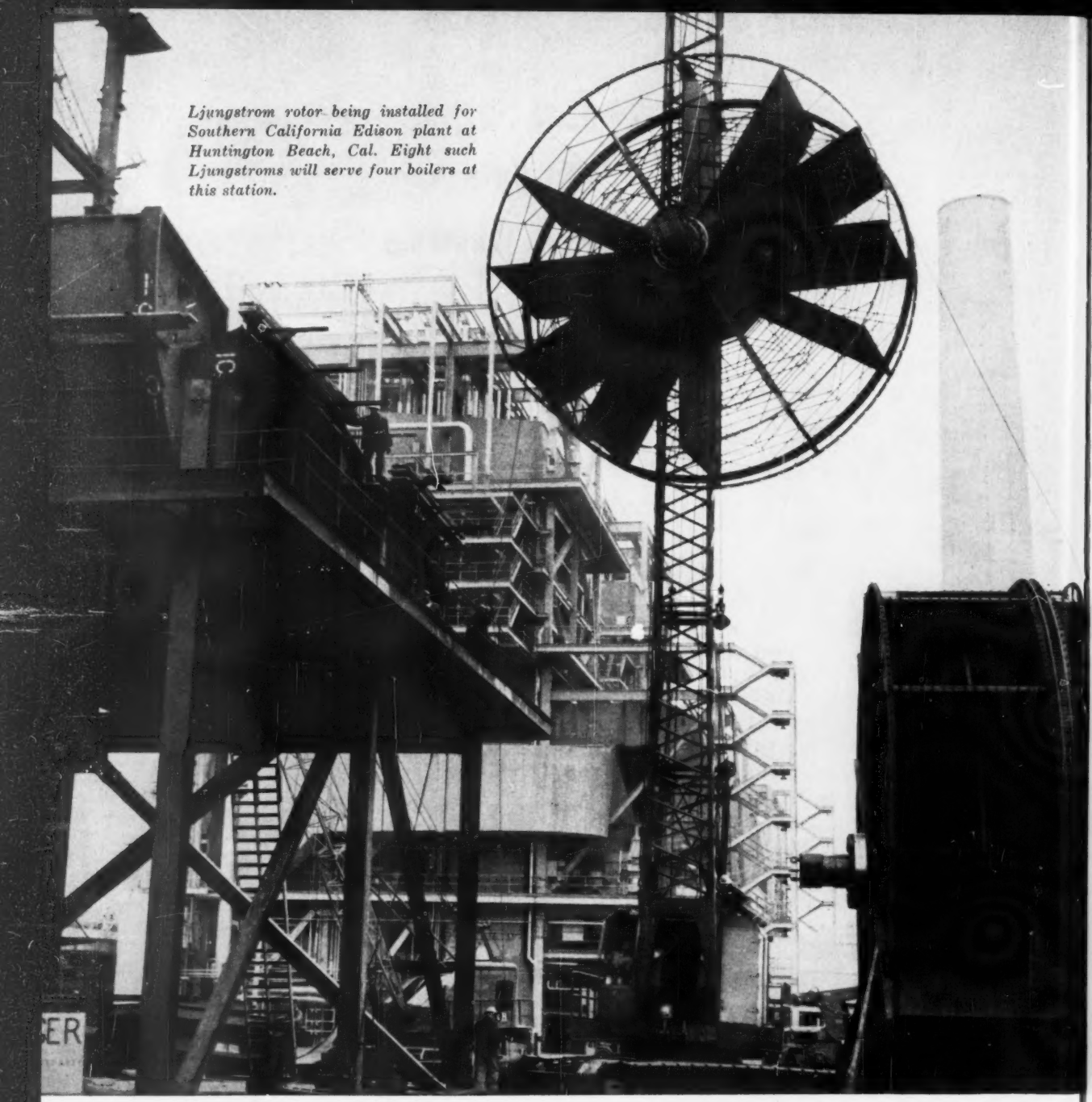
Buffalo Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

For more facts circle 237 on Reader Service card, p 99



Ljungstrom rotor being installed for Southern California Edison plant at Huntington Beach, Cal. Eight such Ljungstroms will serve four boilers at this station.

AIR PREHEATER SERVICE WILL STILL BE IN EFFECT ON THESE UNITS IN THE YEAR 2000

These new Ljungstrom® Air Preheaters, being installed at Southern California Edison's Huntington Beach Station, will be protected by an unusual service policy, one that guarantees regular inspection by Air Preheater engineers throughout the life of each unit.

There's no terminal date on this service — it's in effect as long as the units are in operation. In fact, Lifetime Air Preheater Service is still helping to keep the first Ljungstrom installation in the U.S. running perfectly, although it's been in operation almost 40 years.

Air Preheater provides first-rate *factory* service too, In one instance, in response to a last-minute decision to replace cold-end elements near the end of a scheduled shutdown, Air Preheater *fabricated and shipped* over 13,000 pounds of heating elements the day after the order was received.

Regular inspection and fast factory service are just two of the advantages Air Preheater offers its customers. Another is expert knowledge of boiler and preheater problems, gained through 35 years' experience. This combination—knowledge of customer problems and a *continuing* interest in them — probably explains why nine out of ten preheaters sold today are Ljungstroms.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

For more facts circle 238 on Reader Service card, p 99

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Delivered to the installation site by rail, truck or boat, shop-assembled Vogt Package Water Tube Boilers can be quickly placed in operation. After being placed from the carrier onto a simple low-cost concrete slab, a Vogt unit requires only piping, electrical and stack connections to go to work.

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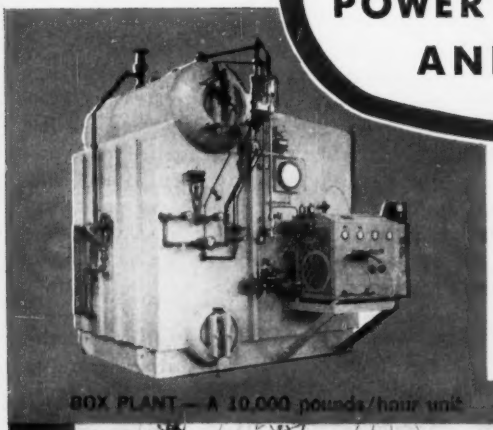

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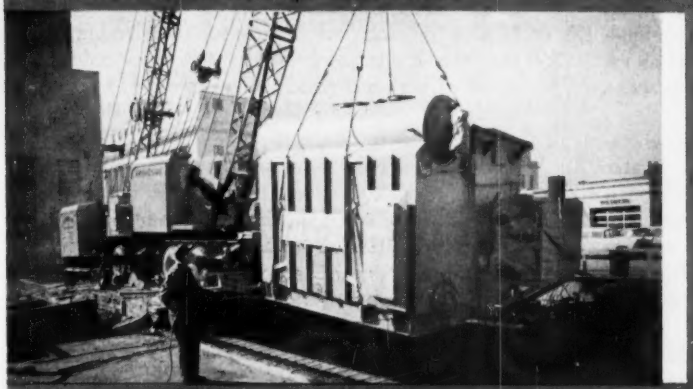

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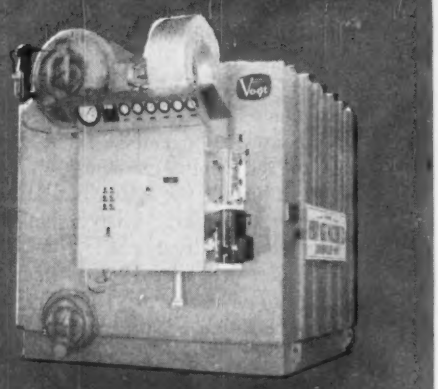

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Technical briefs . . . Latest engineering

Here are your latest water-treatment tips from NACE and 21st Annual Water Conference

The mechanical development of ion exchange. *P H Caskey, Illinois Water Treatment Company*
Progress in the mechanical aspects of ion exchange has kept pace with rapid chemical-process improvement and growth of unit size. Tanks are increasingly code-constructed — a requirement of many utility plants. Early Everdur tanks are giving way to rubber-lined steel but PVC linings are certainly as good for this service. Stainless and stainless-clad tanks are used predominantly in nuclear work but are usually not economical elsewhere.

Quartz is best for underdrains. Anthracite, sometimes used, retains caustic regenerant, prolonging backwash. Plastic pipe and fittings are gaining ground; diaphragm valves are the accepted type except in the very large sizes.

Today, 30% of all ion-exchange plants with capacities over 25 gpm use some form of automatic control. Degree of automation usually depends on basic control philosophy for the total plant. *Annual Water Conference, 1960*

Techniques used in cooling-water treatment, *K C Channabasappa, Wright Chemical Corporation*
Water problems in cooling systems include (1) scale deposits on heat-exchanger surfaces (2) metal corrosion (3) microbiological growth with attendant fouling and (4) chemical and biological attack of cooling-tower lumber. Current preventive practice in each area is detailed.

Scale prevention can be internal (adding chemicals to the cooling system) or external (water treatment outside the system). But in once-through cooling systems, large water volumes preclude economic external treatment. Recirculating systems aim to limit calcium-carbonate scale formation. In addition to adjusting pH, peptizing, colloid-stabilizing and chelating agents are widely used.

Corrosion control through inhibitors includes inorganic-anodic and cathodic types—sodium and potassium hydroxides and salts of zinc and nickel —as well as organic inhibitors such as amines.

A variety of algaecides are on hand to control microbiological growth. Four rules govern treatment to cut cooling-tower deterioration: (1) keep pH between 6.0 and 7.0 (2) use nonoxidizing algaecides and fungicides only (3) keep chlorine residuals (where used) below 1 ppm and (4) use chromate-base inhibitors to prevent chemical attack of lumber surface. *NACE, Northwest Region, 1960*

Pretreatment—the key to effective protection of cooling-water systems, *P R Puckorius, Nalco Chemical Company*
To protect new cooling equipment, initial high-level treatment with a filming inhibitor is supposed to create a protective film after acid cleaning. Then maintenance-level treatment holds the film during operation. Frequently, however, organic substances still present in the system prevent complete film formation; maintenance-level treatment cannot adequately protect metal surfaces. Corrosion begins and continues; untimely failure results.

Tests showed inadequacy of this method on steel-tubed heat exchangers, pointed up need for better surface preparation to insure completeness of initial film formation. From these tests a pretreatment procedure came into being.

Ideally, surface preparation and initial filming should combine into a 1-shot treatment. When no time lag exists between these two steps, no time is available for refouling. This pretreatment procedure provides maximum protection without holidays—unprotected patches where corrosion can start—and permits maintenance-level inhibitor film to give complete and lasting protection. *Annual Water Conference, 1960*

The place of external regeneration in the design of high-rate condensate-scavenging systems, *D M Spillane, V J Calise, Graver Water Conditioning Co*
Bypass or full-flow condensate scavenging continuously treats power-cycle water. Aim: minimize effect of major contaminant sources: (1) makeup solids (2) condenser leakage (3) corrosion products formed in the cycle (4) silica. History of modern condensate-scavenging systems is short, though there are a few older units, but benefits were easily recognized. Systems are mandatory in supercritical-pressure units and some subcritical once-through steam generators; their economic benefits extend well down the pressure scale—to 1800 psi at least.

Modern condensate-scavenging units at Louisiana Power & Light, Southern California Edison and TVA are detailed, others shown schematically.

External regeneration of scavenging mixed-bed demineralizers adds several advantages: (1) no acid or caustic in the main cycle (2) less air contamination (3) increased availability and flexibil-

Directions for ordering these papers on p 96

ity. Future may reverse emphasis in power-cycle water treatment—from makeup to cycle condensate—as next step in power-plant simplification. *Annual Water Conference, 1960*

Treating today's circulating cooling water, *M Brooke, Phillips Petroleum Company*
Four basic steps in closed-circuit cooling-water treatment prevent (1) scaling—by removal or treatment of scale-forming constituents (2) corrosion (3) fouling and (4) tower deterioration.

Choice between scaling-prevention methods, removal and treatment depends on local conditions. As a general rule, pretreatment should be checked if makeup water tests at more than 100-ppm total hardness and costs more than 5c per 100 gal delivered to the cooling-tower basin.

Blowdown limits buildup of solids in cooling-water system. Ratio of makeup to blowdown quantities is called "cycles of concentration." Example: if makeup hardness is 50 ppm and limit of solubility is 200 ppm, cycles of concentration must be maintained below 200/50 = 4 to prevent scaling. So blowdown must be greater than ¼ or 25% of the makeup quantity.

Evolution of each basic step is outlined; present state of each is covered. Influence of outside factors, such as tower construction materials, on treatment is discussed. *NACE, Northeast Region, 1960*

Water-treatment experience during the start-up and initial operation of the Avon supercritical unit, *H J Vyhnalek and C D Banks, The Cleveland Electric Illuminating Company*
In December 1959, Cleveland Electric Illuminating Company started up its supercritical unit at Avon Station—215 mw, 3775 psig, 1110/1050 F. By-pass condensate-scavenging system continuously polishes hotwell condensate. For maximum protection, hotwell is compartmentalized and system draws condensate from sections nearest tube sheets where leakage is most apt to occur.

System to handle 100% condensate flow contains two precoat filters, three mixed-bed demineralizers (in-place regeneration) and three cartridge effluent filters (resin traps). No-solids internal treatment controls corrosion and adjusts pH.

Early filter runs were short because of high crud level. They've now lengthened as cycle has cleaned up. Demineralizer runs of three months between regenerations indicate low load factor. Effluent filters run six months between replacements.

Startup and initial cycle-cleaning experience is detailed; steps taken to overcome difficulties are covered. *Annual Water Conference, 1960*

Corrosion problems

Continuous corrosion monitoring with corrosion probes, *E S Troscinski, A S Couper, A Dravnieks, Standard Oil Company (Indiana)*
Visual corrosion monitoring is only possible during equipment shutdown; even then many areas cannot be inspected without dismantling piping and equipment. Corrosion coupons—specially prepared samples—help this inspection process but still you usually must await a shutdown to inspect them.

Corrosion probes give continuous and accurate corrosion-rate data. Their operation is based on changes in electrical resistance with reduction in cross-section area caused by corrosion of the probe itself. A measure of accuracy: 1 or 2 micro-in. is commonplace; a rate of 0.005 ipy (in. per yr) can be detected from measurements taken only a few hr apart.

Effect of corrosion products on corrosion rate is one factor governing materials used as probes. AISI type-316 stainless steel appears promising but Hastelloy C can be relied on if type 316 proves unsuitable.

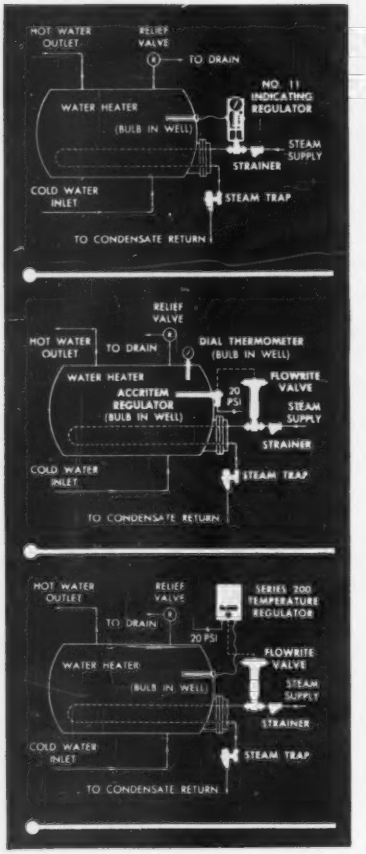
Uses of corrosion probes are many: (1) rapid evaluation of corrosivity of a new process (2) corrosion monitoring of critical areas in a new process (3) a check of effects of operating changes and (4) evaluation of stream composition and corrosion inhibitors. *ASME 60-PET-7*

The composition of corrosion products formed in steam condensate, *R D Eberhardt, E W Arenson and C E Imhoff, Allis Chalmers Manufacturing Co*
Closely controlled tests show products of corrosion formed in various steam atmospheres. Tests used polished coupon samples of carbon steel, cast iron, Admiralty, Muntz metal, aluminum 3003 and zinc. Apparatus gave precise control and measurement of steam environment; pH determination, condensate-purity control and various dissolved-gas concentrations permitted wide test range.

Some conclusions: (1) at 5.0 to 9.6 pH, magnetite formed on steel samples. Basic ferric oxides formed more frequently at pH values above 7.0. (2) Cuprite was most-stable copper corrosion product of either Admiralty or Muntz metal at pH less than 6.0 but rarely formed above pH of 7.0. In Muntz metal, corrosion products were soluble in 2-ppm or more ammonia solutions and dezincification occurred. (3) Metallic zinc corroded to zinc oxide over a pH range of 5.1 to 9.6. Details of corrosion at varying temperatures and dissolved-gas concentrations are tabulated. *NACE, North Central Region, 1960*

continued

Practical Ways To Control Hot Water Storage Heaters



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Technical briefs

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Cleaning

Alkaline cleaning of new high-pressure main units prior to startup, *A A Pace, Duquesne Light Co*

Steps in normal high-pressure-unit cleaning: (1) manual and chemical cleaning of the condensate cycle (2) strong-alkaline boilout of the boiler (3) acid boilout of the boiler (4) alkaline conditioning of the boiler and (5) high-pressure-steam blowout of the main steam leads. This discussion covers steps (1) and (2) only.

Manual portion (1) removes construction debris, temporary protective coatings, loose mill scale and water-soluble and saponifiable lubricants used during construction.

Alkaline cleaning (2) must be capable of penetrating layers of dirt by attacking binder material holding dirt together. It must have good emulsifying properties to remove animal, vegetable and mineral oils, be a good deflocculator to prevent redeposit of entrained material. Lastly it should be free-rinsing and leave no afterdeposits. Trisodium phosphate, caustic soda and soda ash have been widely accepted as good alkaline cleaners.

Flush after cleaning requires velocities at least as high as normal operating flows. Lesser flush rates permit settling out.

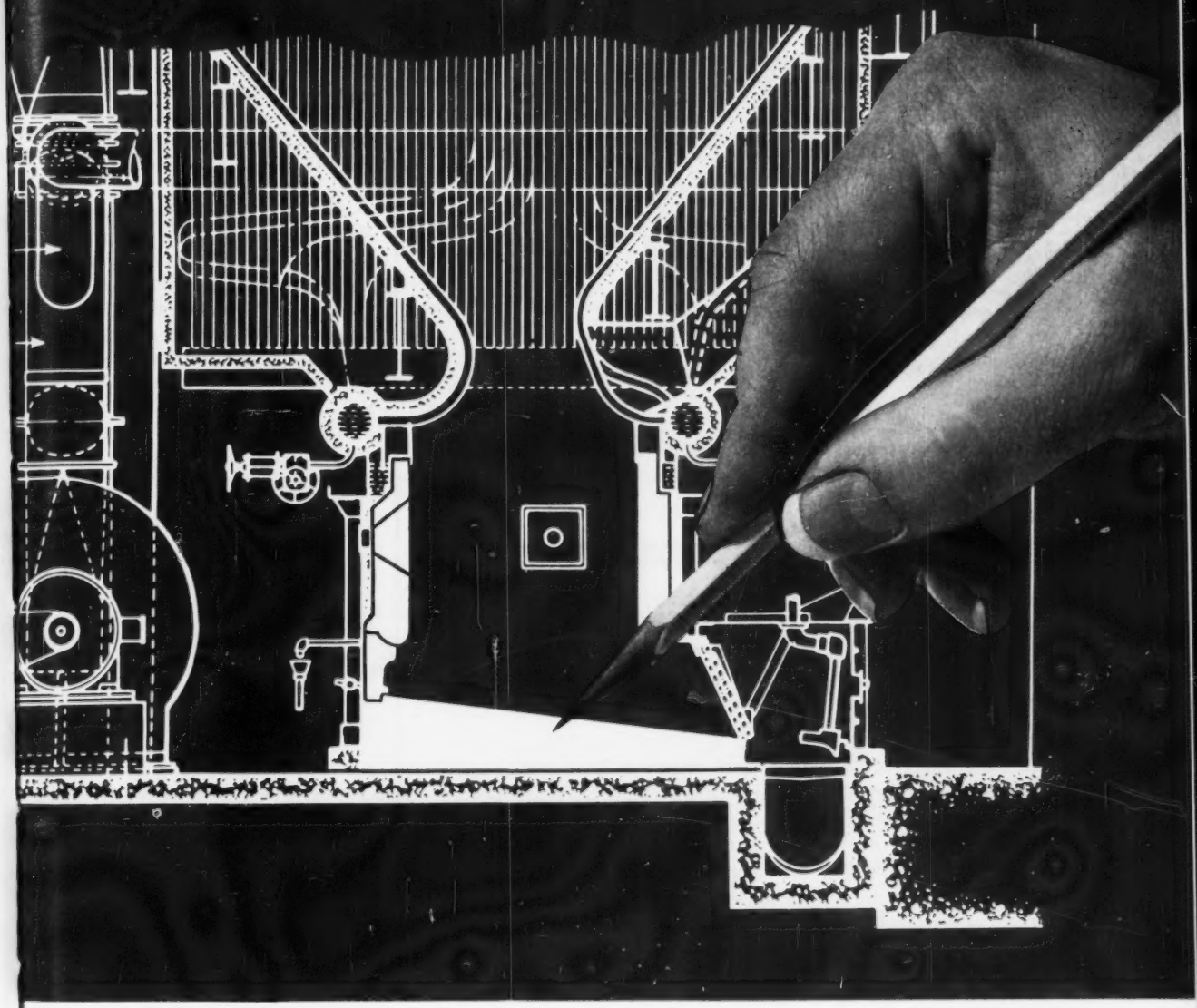
Procedure for a specific Duquesne Light unit is detailed and chemical costs are given. *Annual Water Conference, 1960*

Chemical cleaning of preboiler equipment, *W B Willsey, Philadelphia Electric Company*

If boiler chemical cleaning is considered a necessary part of unit startup, and it invariably is, then it is completely illogical not to clean the preboiler cycle as well. Yet this latter step has only recently been taken and some controversy still exists.

Obviously the optimum is complete cleaning, including both water and steam sides of all preboiler components and all interconnecting pip-

How to draw the line on ashpit maintenance



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Relining ashpits is expensive and time-consuming. That's why more and more utilities and industrial companies are specifying a heavy-duty refractory castable such as B&W Kaocrete D. On job after job, it has withstood the heavy abrasive or erosive attack of sprays, jets, rakes or shovels.

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R-549

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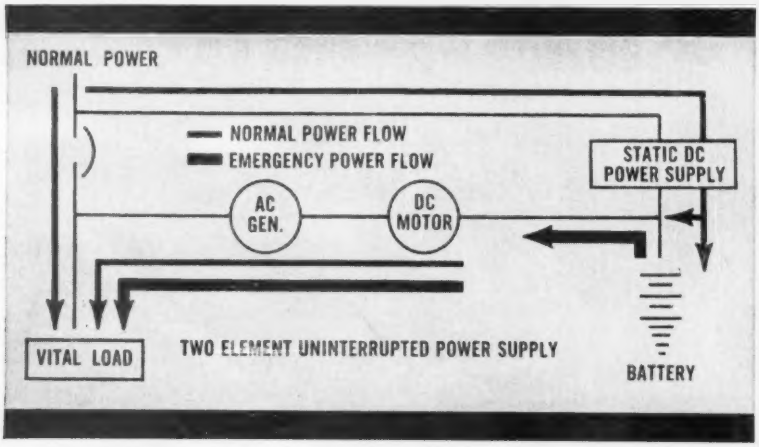

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Technical briefs

Begins on page 88

ing. An intermediate step that promises success: chemically clean water side only and blow down all heater drips during initial operation. This eliminates steam-side cleaning—most difficult part of the job.

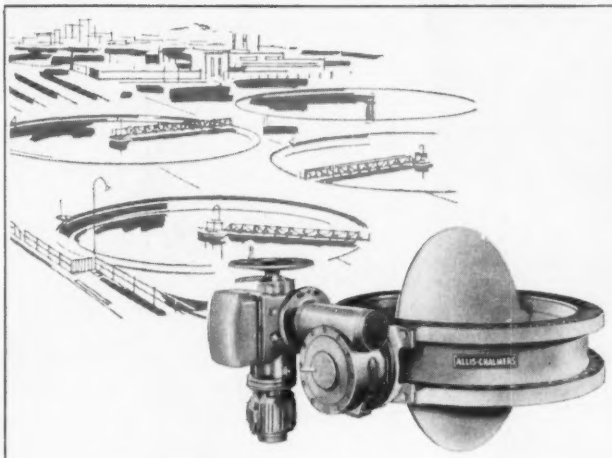
Steps in preboiler cleaning are about the same as for the boiler. But there are some other considerations: (1) Liquid velocity must be as high as maximum operating velocity—preferably higher. Remember, there are many long horizontal pipe runs to be cleaned and flushed. (2) Passivation should be considered as a final step in preboiler cleaning if cycle is to remain idle for more than a few days after cleaning. (3) After each flush, cycle should be isolated and recirculated long enough to be sure no hidden pockets of acid or contamination remain to feed into the cycle. (4) It may be convenient to break the cycle into sections for chemical cleaning rather than do it in one fell swoop. Particular cycle layout dictates optimum procedure here. *ASME 60-WA-262*

Chemical cleaning of controlled circulation boilers, *H J Vyhnalek, The Cleveland Electric Illuminating Company*

Single-stage acid cleaning of steam generators can lead to copper replating bare steel surfaces. But recent development of copper-complexing agents can prevent the replating process, add the advantage of shorter outage time and removal of copper-iron laminar deposits. A word of caution, however; agents are effective copper removers only under certain very specific conditions; they increase corrosion rate of inhibited hydrochloric acid.

Life of a controlled-circulation boiler tube is governed by condition of its particular flow-control orifice. Deposits here can starve the tube, cause overheating and premature failure. Analysis of deposits is necessary to determine best cleaning method. High copper-bearing deposits will almost certainly give uncertain results when using only complexed acid. A 2-step cleaning proc-

ALLIS-CHALMERS



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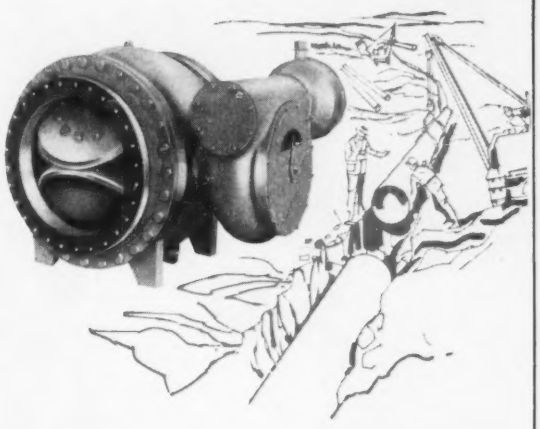
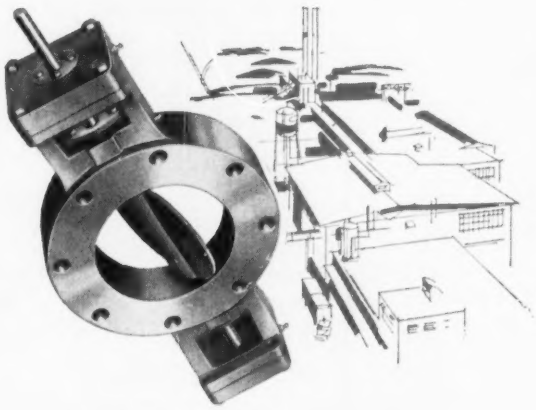
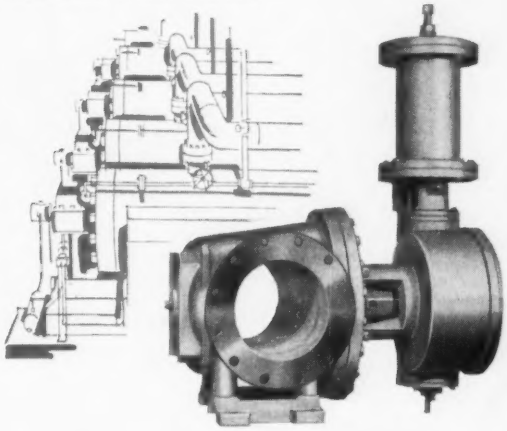


BALL VALVES — Easy manual shutoff under adverse conditions, and up to 150 psi. Slight wedging action gives unusually drop-tight closure. Sizes: 12 to 48 in.



WAFER VALVES — A new design of butterfly valves with space-saving flexibility, suited to most any type of operation. Sizes from 3 to 36 in., including high-pressure types.



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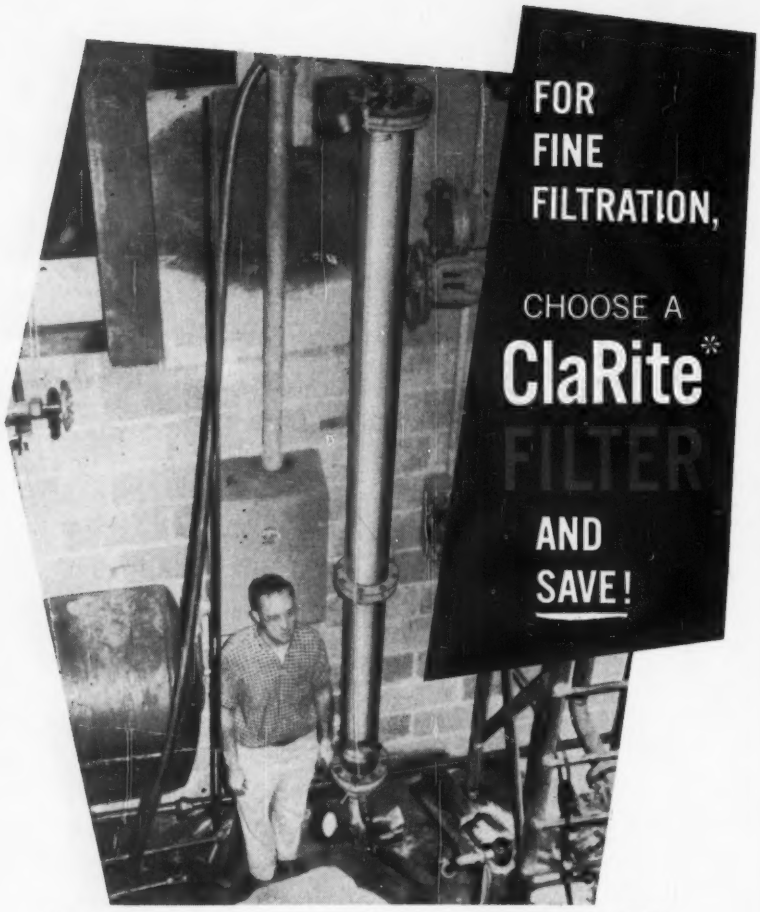

Undergoing laboratory testing at Croll-Reynolds: one of the ClaRite 'Wedgewire' filter elements for three 415 square-foot units designed to filter condensate in a high-pressure generating station

A ClaRite filter removes particles down to 1/10 of a micron by the precoat method — saves you money and floor space too

This picture offers proof of precoating efficiency that no other filter tube can match. The 'Wedgewire'* tube is 9 feet long by 2¾ inches in diameter — yet it retains an even precoat over its entire length. As the effective length of the filter tube increases, the number of tubes needed to meet filter area specifications decreases proportionately.

Q.E.D.: Fewer filter tubes are needed in a ClaRite filter assembly and the pressure vessel may be smaller. You save three ways — on installation costs, on the cost of the pressure vessel, and on floor space.

Another feature of a ClaRite filter: It can be cleaned effectively and completely by the backwash method. Disassembly is not necessary.

A ClaRite filter has no moving parts. Rugged, permanent filter elements, heavy duty construction and high quality accessory components slash maintenance costs and permit operation at extreme pressure drops. ■ The exclusive design of the 'Wedgewire' element assembly allows faster flow rate than other types of equipment of equal area. ■ For a booklet describing the ClaRite filter, write to the Croll-Reynolds Engineering Co.

*Croll-Reynolds' trademark

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For more facts circle 244 on Reader Service card, p 99

Technical briefs

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ess has merit in controlled-circulation boilers since flow-control orifices are normally located in the lower part of the boiler. *ASME 60-WA-258*

Chemical cleaning with citric-acid solutions, *W E Bell, Charles Pfizer and Company*

Inhibited citric acid has been used in many cleaning operations over the past 18 months, but only a few have used ammoniated citric acid. Reactions between citric acids and ferrous or ferric ions are covered. Results: where slight but uniform corrosion of the acid solution gives an atmosphere that reduces ferric to ferrous ions, ammoniated 3% citric acid (pH 3.0 to 3.5) can be used without precipitating ferrous acid citrate. Under these conditions, citric acid can be used where it is known that solubility limit will not be exceeded. Data presented show that this limit is near 0.04% ferrous iron.

Lower inherent corrosion of bare metal is another inherent advantage of ammoniated citric acid. And ability and efficiency in dissolving red rust are equal to citric acid. *ASME 60-WA-257*

The use of inhibitors in commercial cleaning operations, *J P Engle, C E Fox and C F Reich, The Dow Chemical Company*

Selection of a solvent system—solvent and inhibitor—for any specific cleaning job should be based on three checks. (1) It must not produce general attack, but (2) it must effectively attack all deposits to be removed (3) it must balance economically. Cleaning rate itself is governed by acid strength, velocity (agitation) and temperature.

While violent agitation speeds cleaning by bringing new acid into contact with the deposit, it also makes inhibition more difficult for exactly the same reason. Some inhibitors are effective over a wide range of acid concentrations; some are not. Tests are needed here. High cleaning temperatures increase chemical reaction —about double for each 10-deg rise.

continued

NEW ENGINEERED TEFLON PISTON RINGS

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Garlock Teflon* Piston Rings may be used alone where piston is lightweight, vertically installed, or supported by tail rod (upper left). On large compressors and cylinders with heavy pistons, Teflon Rider Rings are recommended to support the piston (lower left).

Time after time, Teflon Piston and Rider Rings—the newest of Garlock products—prove effective in extending ring life under non-lubricated or chemical service.

A compressor used in wet hydrogen service was fitted with six rings of Teflon. Lubrication was eliminated and the rings were still in service after 2000 hours. Cast iron piston rings previously used needed lubrication and lasted less than 100 hours.

Another compressor operated at +350°F to supply instrument air. With Teflon Piston Rings, the compressor has been in continuous service for over 2500 hours without lubrication; the radial wear rate is approximately .009 per 1000 hours. Before this, the cylinder had to be lubricated; it was also necessary to periodically remove oil from the discharge air to prevent entry into instrument air lines.

The first really satisfactory piston rings for non-lubricated service, Garlock Teflon Piston and Rider Rings are engineered for longer life and better heat dissipation. They have the lowest coefficient of friction of all materials, are chemically inert, and will not contaminate the gas or fluid in the system. Garlock Teflon Piston and Rider Rings will not crack or break, will not score cylinder walls, and are flexible for easy installation. They can be applied at temperatures from −420°F to +500°F, are available in carbon-graphite filled Teflon or glass-filled Teflon, and come in either butt joint, step joint, scarf cut or solid, depending on your needs.

Talk to your Garlock representative about Teflon Piston and Rider Rings. He is backed by years and years of experience in the design, manufacture and application of packings and seals of all types. You will find him in your locale at the nearest of the 26 Garlock sales offices throughout the U.S. and Canada. Or, write for Catalog AD-178. Garlock Inc., Palmyra, New York.

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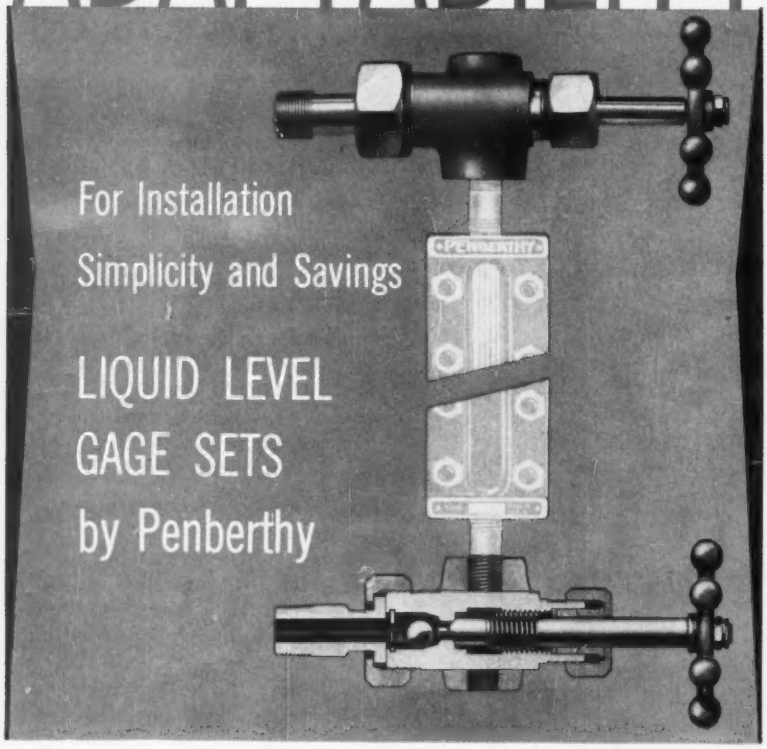

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Technical briefs

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But stable inhibition may be impaired if temperature is too high; inhibitors may oxidize, break down or react with other chemicals present. Again a test will show highest possible cleaning temperature consistent with good inhibition. *NACE, Northeast Region, 1960*

Atomic energy

A compendium of information for use in controlling radiation emergencies (*TID - 8206 — rev*), $1.00. **Fossil fuels in the future** (*TID-8209*), 75c. Contact Office of Technical Services, U.S. Dept of Commerce, Washington 25, D.C.

1960 research and development report on the advanced epithermal thorium reactor. Limited number of copies available at no charge from public relations dept, Atomics International, PO Box 309, Canoga Park, Calif.

Index of technical journals published by AEC can be obtained from U.S. Atomic Energy Commission, Technical Information Service Extension, PO Box 62, Oak Ridge, Tenn.—no charge.

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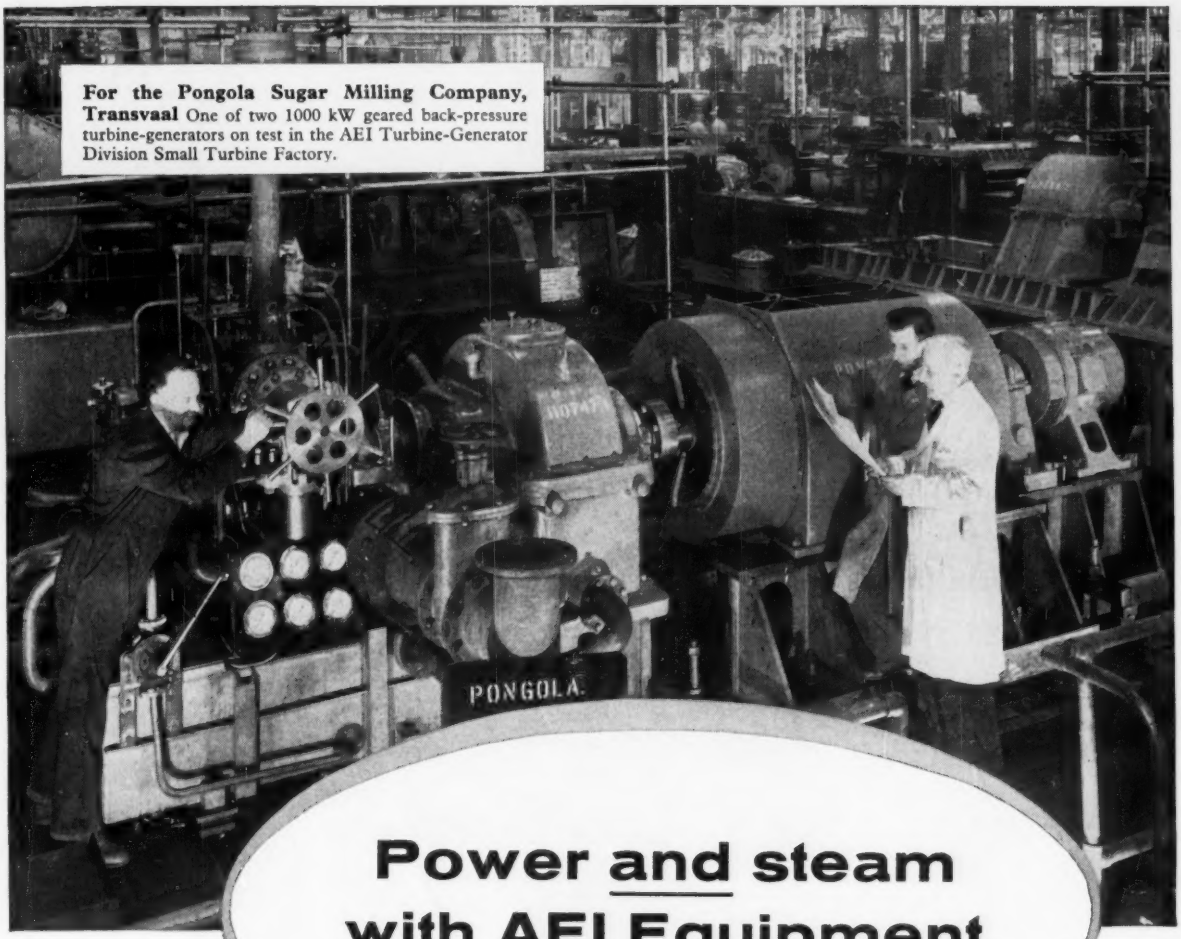
Annual Water Conference. To be published in book form. Contact The Engineers' Society of Western Pennsylvania, Penn-Sheraton Hotel, Pittsburgh 30, Pa. Price, $10.00.

NACE. Reprints will be available after publication in *Corrosion.* Contact National Association of Corrosion Engineers, 1061 M & M Building, Houston 2, Texas. Prices not established.



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101 **Selector chart** shows properties of firm's adhesives and hardeners, tensile shear strengths at different temperatures and in several fuels. Bulletin A-100 tells story. Hysol Corporation

102 **Nodular cast iron's** advantages as control-valve-body material is covered in tabular form in paper from Fisher Governor Co

103 **Wire-cloth** and wire-screen products are topic of loose-leaf spec catalog available from The Cleveland Wire Cloth and Manufacturing Co

• Coatings

104 **Finishes** for magnesium, how to specify them are discussed in reprint. Dow Metal Products Co

105 **Cold-applied** protective coatings are described in bulletins T-197-3, T-97-61. Koppers Co

106 **Plating process** is described, applications explained in booklet. Selectrons, Ltd

• Instruments

107 **Temperature chambers** for —150 to +300 F, temperature tools are covered in articles available from Cincinnati Sub Zero Products

108 **Digital speed-measurement** systems are topic of 6-p bulletin 2000. Spec tables coordinate with application recommendations. Meriam Instrument Co

109 **Tachometers,** 19 types, are shown in 12-p bulletin 62. Drawings show shafts, drives, drive arrangements. Jones Motrola Corp

110 **Conductivity monitors,** continuous indicating type, are detailed in data sheet E-95(3). Leeds & Northrup Co

111 **Temperature - conversion** chart converts from any scale, includes Kelvin, Rankin, C and F. Rosemount Engineering Co

112 **Infrared** radiation pyrometers for permanent installation or portable use are covered in bulletin TB 1372 available from Servo Corp of America

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114 **Temperature-control** bulletin 109 describes indicating differential-expansion type control for electric operation. Burling Instrument Co

115 **Autographic plotters,** seven models of multirecord type, are detailed in bulletin PG-100. Application data, specs are included. Gilmore Industries

116 **Recorder-indicator** catalog C 15-1a has 48 pp, shows new design features. Well-illustrated catalog gives tables and charts. Minneapolis-Honeywell Regulator Co

117 **Electronic process-control** system, closed-loop type, is topic of 8-p brochure 10. Capacitance-actuated level-detection and control units, malfunction detectors are described. Robertshaw-Fulton Controls Co

118 **Pushbutton stations** and control units, color-coded, are shown in 8-p brochure PL 100-1-960. The Clark Controller Co

119 **Differential** pressure transmitter is featured in spec sheet 230-1. Ordering info speeds selection. Minneapolis-Honeywell Regulator Co

● **Piping, valves and fittings**

120 **Tubing,** mechanical and hydraulic electric-resistance-welded carbon-steel type, analyses of standard carbon, alloy and stainless tubing steels in corrosion resistant service are topics of bulletins T-456, T-459. Babcock & Wilcox Co

121 **Weight computations** for welded steel tubing are made easy with tables available from Jones & Laughlin Steel Corp

122 **Hose selection** is charted in booklet 627. Over 112 liquids and gases are listed. Aeroquip Corp

123 **Pressure regulators** and valves are described in bulletin 136. American Meter Company

124 **Rubber-seat** ball valve in 150- or 250-psi ratings are featured in in folder BA-1. Henry Pratt Co

125 **Stand-off fasteners** for supporting tubing, wire bundles, equipment and instruments are detailed in booklet from Western Sky Industries

126 **Band, hose clamps,** couplings, flanges, V-band joints are covered in 44-p catalog 803. Features, design info, specs speed ordering. Aeroquip Corp

Jan 1961 issue **Circle numbers below for FREE data** Card void after April 1, 1961

PLANT EQUIPMENT in the news this month, starting on p 112

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

NEW LITERATURE listed in this issue, starting on p 99A

101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
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176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200

ADVERTISED PRODUCTS appearing throughout the issue

201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225
226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275
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SEARCHLIGHT SECTION for used and rebuilt equipment, starting on p 179

500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524
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NEW FREE LITERATURE continued.....circle key numbers, page 99, for your copies

● **Prime movers**

127 **Packaged emergency system** for uninterrupted power supply resembles diesel-generator set in appearance but differs in performance. System is always on the line. Story is in booklet available from Consolidated Diesel Electric Corp

128 **Gas turbine,** single-shaft 9000-hp type for mechanical and generator drive is presented in bulletin 186. Clark Bros Co

129 **6500-hp gas turbine** is featured in brochure with specs. Orenda Engines Ltd

130 **Gas turbines** for various industrial uses are outlined in bulletin GED-5685. General Electric Co

● **Maintenance**

131 **Removing** and controlling microscopic dirt from lubricants and hydraulic fluids is described in brochure. Explains test procedures for determining micron and submicron contamination in fluids. Gelman Instrument Co

132 **Chemical cleaning** with citric-acid solutions is detailed in data sheet 557. Chas Pfizer & Co, Inc

● **Welding**

133 **Electron-beam welding** unit is topic of reprint. Discussion includes graphs and illustrations. Air Reduction Sales Company

134 **Award program** for welded design is described in booklet. Requirements and qualifications are listed, typical award-winning projects shown—welded coal unloader, pump housing, gears. Arc Welding Foundation

Air-conditioning systems

● **Ventilation**

135 **Rotary soot blowers,** air powered, electric and manually operated, are topic of bulletins 1067, 1071 and 1072. Copes Vulcan Div, Blaw-Knox Co

136 **Hooding methods** for controlling fumes from electric furnaces are covered in 8-p bulletin. Wheelabrator Corp

● **Air conditioning**

137 **Motor-run capacitors** for air conditioning, refrigeration, heating and ventilating are topic of 2-p bulletin 55. John E Fast & Co

138 **Air-conditioning** units, packaged central-station types, feature selection of new filters. Details are in 60-p book AC-100. Charts, graphs, tables aid selection. American Air Filter Co, Inc

139 **Controls,** electric and electronic, for air-conditioning applications are covered in handbook. Barber-Coleman Company

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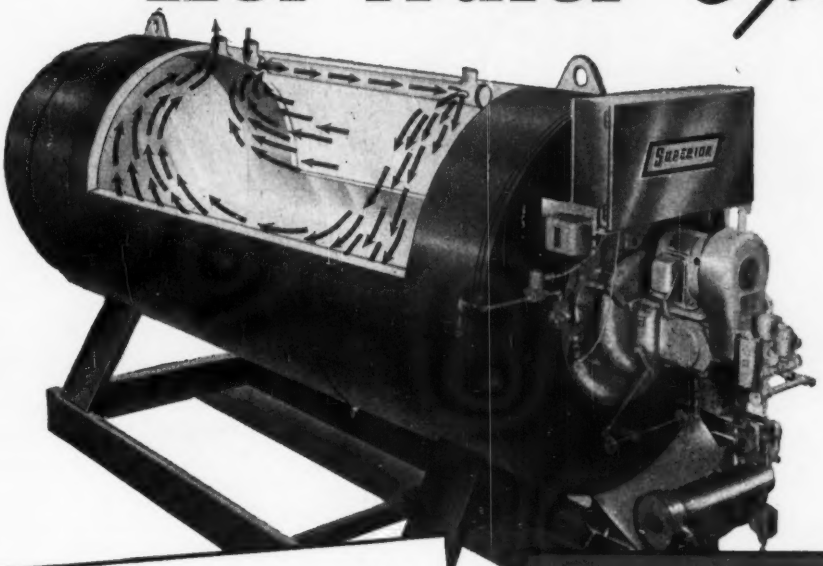


with...

Venturi-Action Mixing-Tube

Venturi-Action Mixing Tube
plays a triple role:

1 It starts by mixing entrained water from the boiler with water entering the boiler.

2 Traveling through the tube, temperature is further modified by the surrounding water.

3 Jet action at the end of the tube directs flow downward and outward against the outer confines of the shell, providing a circulation pattern unequalled in any other hot water boiler.

SUPERIOR "TYPE CC"

This new Superior Hot Water Boiler eliminates the problems resulting from the use of steam boilers for hot-water heating. Most of these stem from improper circulation within the boiler.

Its newly designed Venturi-Action Mixing-Tube achieves a more effective use of the natural flow pattern for maximum efficiency in hot water heating.

In addition to its special hot-water design, features include 4-pass down-draft design, 5 sq. ft. of heating surface per bhp., built-in induced draft, fully automatic operation firing gas, oil or both, and a host of other features described in detail in the new catalog illustrated at left.

For sizes to 11,720,000 Btu's/hr., write for catalog CCW-11.
For sizes to 20,100,000 Btu's/hr., write for catalog CFW-11.

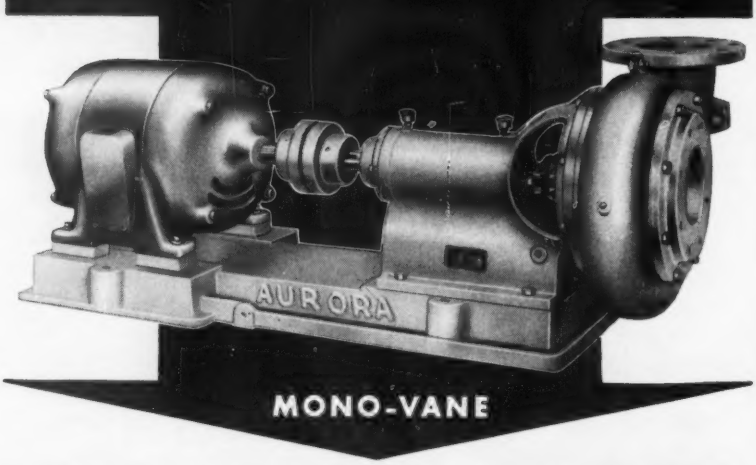
Fire-Tube and Water-Tube PACKAGED BOILERS
for STEAM or HOT WATER

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N. Y.

SUPERIOR PACKAGED BOILERS ®

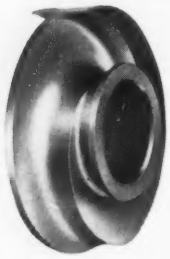
For more facts circle 250 on Reader Service card, p 99

AURORA® CONTROLLED PERFORMANCE



NON-CLOG PUMPS

"The Pump with the single passage impeller"



MONO-VANE IMPELLER

- CAPACITIES TO 1000 G.P.M.
- HEADS TO 150 FT.
- BALANCED IMPELLER
- HORIZONTAL OR VERTICAL
- RUGGED CONSTRUCTION
- PROVEN DEPENDABILITY
- MINIMIZED WEAR
- FAST INSTALLATION
- EASY MAINTENANCE

The Mono-Vane impeller is in hydraulic and dynamic balance. It can be trimmed to suit various head and capacity requirements and still retain proper balance. The AURORA Non-Clog Pump is ideal for handling long stringy materials. Smooth, quiet operation is assured with the Mono-Vane impeller which is always in dynamic and hydraulic balance—even when trimmed to accommodate various head and capacity requirements. Single passage impeller design makes the AURORA Non-Clog pump ideal for handling long stringy materials. The discharge may be turned to any position to facilitate installation, service and maintenance. Clean-out cover is located in casing to provide easy service access.

Typical applications: elevating sewage, pumping sludge, handling heavy settleable solids, effluent, and other wastes and industrial by-products.

WRITE FOR BULLETIN 121 MV

AURORA Always PUMPS

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
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For more facts circle 251 on Reader Service card, p 99

Free literature

Gas systems

140 **Vertical compressors,** packaged type for 125 psi in 50- to 2000-hp sizes, are topic of 8-p catalog V-100. Bury Compressor Company

141 **Loading panels** for remote manual control of pneumatically actuated valves, cylinders, etc are described in folder from Mason-Neilan Div of Worthington Corp

142 **Gas-survey recorder** cuts load-research costs. Details in 4-p catalog 35-1543. Fischer & Porter Co

143 **Governor** for gas-air applications is featured in 4-p bulletin 114. Operating and design features are given. American Meter Co

144 **Air-comparison,** Pycnometer, for nondestructive volume measurement is described in brochure 786. Device is hand operated, requires no power source. Beckman Scientific and Process Instruments Div

Steam and hot-water systems

- **Hot-water heaters and boilers**

145 **Reference guide** to ASME boiler and pressure-vessel code (section VIII) is available in handy wall chart from Missouri Boiler and Tank Company

146 **Storage-water heaters** are topic of 8-p bulletin 61. Specs cover 55 sizes in both vertical and horizontal models, 114 sizes of removable U-tube heating elements. Niagara Weldments Inc

147 **Liquid-phase heater** operates to 800 F, comes in 1,250,000- to 4,375,000 Btu-input sizes. Bulletin 4023 tells story. Vapor Heating Corp

- **Burners**

148 **Packaged oil burner,** pressure-atomizing type, is topic of 4-p bulletin 100A. National Airoil Burner Co, Inc

149 **Firing equipment** for gas, oil, coal is covered in 12-p bulletin AIA 30-C-1. Iron Fireman Manufacturing Company

150 **How refractories work** for industry is title of 16-p report covering raw materials, research and production of refractories. Harbison-Walker Refractories Co

Begins on page 99A

151 **Fire-clay refractories** are featured in 8-p brochure. Firm's principal brands are described. Harbison-Walker Refractories Co

152 **Refractory-fiber** insulation is described in data sheet IN-283A. Johns-Manville Corp

- **Materials handling**

153 **Cradle idler** and belt conveyor are topics of brochure 660. Dimensional drawings, capacity tables included. The McNally Pittsburgh Mfg Co

154 **Carriers,** cranes, overhead equipment are covered in 12-p booklet 2008-Q. Cleveland Tramrail Div of Cleveland Crane and Engineering Co

Liquid-handling systems

- **Water treatment**

155 **Maintaining an alkaline pH** in steam and condensate-scavenging systems is explained in bulletin. Ionac Chemical Co

156 **Regenerating ion-exchange** units externally in condensate scavenging systems is subject of reprint T-182 available from Graver Water Conditioning Co

157 **Pretreatment** for effective corrosion control is title of water-conditioning data sheet. Betz Laboratories, Inc

158 **Determining boron content** of water down to parts per million with continuous automatic method is covered in 2-p data sheet. Technicon Controls, Inc

159 **Tray deaerators** for corrosion protection in boiler feedwater systems are topic of 4-p bulletin. The Permutit Company

- **Pumps and valves**

160 **Split-case pumps,** 2-stage vertical type, are featured in bulletin. Capacities range to 1400 gpm, heads to 425 ft. The Aurora Pump div of The New York Air Brake Co

161 **Submersible-pump** reference catalog covers firm's full line. Kenco Pump Div of American Crucible Products Co

162 **Single-stage pumps,** side-suction open-impeller type, range up to 115 gpm for small amounts of corrosive chemicals or slurries. Goulds Pumps, Inc

163 **Hydraulic valve actuator** locks automatically, holds gate or plug

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ROTARY & CENTRIFUGAL PUMP PAC
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INGS • HYDRAULIC
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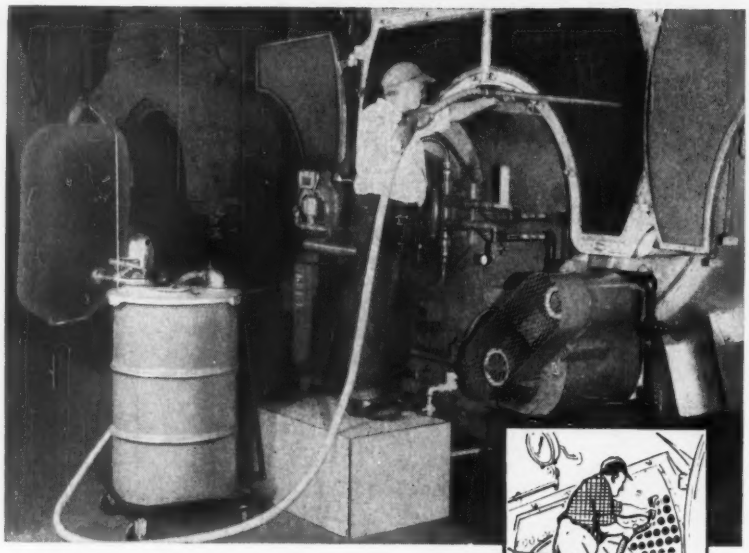
CUT FUEL BILLS... CLEAN YOUR BOILERS WITH TORNADO®



FRONT CHAMBER

PUNCHES TUBES

REAR CHAMBER

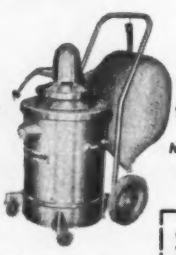
SAVE UP TO 40% THE NEW JUMBO VACUUM BOILER CLEANING WAY

Take a look at your fuel bills and imagine what it would mean if you could save 25% or up to 40% of this cost.

The new Tornado Method of Boiler Cleaning with a Tornado Jumbo Vac can mean this savings to you. What's more, boiler cleaning becomes an easy task for anyone when Tornado is on the job.

Tornado Jumbo Vacs fit right on any standard 55 gallon drum. Complete attachments and a 4 wheel dolly are available.

WRITE FOR BULLETIN 951 "TORNADO METHOD OF BOILER CLEANING"



TORNADO® 400

THE VERSATILE VACUUM CLEANER OF MANY USES

This famous wet or dry pickup vacuum cleaner has a removable motor unit that can be removed to make a blower or pac carried vacuum cleaner. Available in 3 motor sizes, this powerful machine does every cleaning job better and faster. WRITE FOR BULLETIN 894-A.

SEE US AT BOOTH NO. 946 for Complete Demonstration
NATIONAL PLANT MAINTENANCE & ENGINEERING SHOW
International Amphitheatre, Chicago
January 23 - 26

Gentlemen:
We would like to reduce our heating costs with improved boiler cleaning. Please have your distributor contact us for a demonstration.

NAME.....
COMPANY.....
STREET.....
CITY.....ZONE...STATE.....

BREUER ELECTRIC MFG. CO.

5144 NORTH RAVENSWOOD AVENUE, CHICAGO 40, ILLINOIS

Free literature

Begins on page 99A

in any position, has motor and pump which run only for valve opening and closing. Details are in bulletin VA-10. Oil-Dyne, Inc

Mechanical transmission systems

164 **Flexible cushion couplings** for high-speed high-torque applications or for attaching to i-c-engine flywheels are described in 20-p bulletin from Dodge Manufacturing Corp

165 **Modern gears,** advanced concepts are featured in publication describing firm's production methods, facilities. Philadelphia Gear Corp

Electrical systems

- **Generation and transformation**

166 **Single- and 3-phase transformers,** ventilated dry type for indoor installation, are covered in 8-p bulletin 160. Niagara Transformer Corp

167 **Load-tap changers,** bushing mounted for power transformers rated 120,000 kva and above, are topic of 4-p bulletin GEA-7133 available from General Electric Co

168 **Motor-generator** equipment, 400 cycle, is covered in bulletins. Precision Power Div of American Electronics, Inc

- **Distribution and protection**

169 **Planning** industrial power-distribution systems for safety, reliability and economy is discussed in 48-p bulletin GEA-7139. General Electric Company

170 **Fuse panels,** service-entrance equipment and switches are covered in 20-p publication PL 12-29-660. The American Electric Switch Div of The Clark Controller Co

171 **Connectors,** receptacles, switches are illustrated, specs given in 4-p bulletin B81. Joy Manufacturing Co

172 **Interrupter switch,** fused type for 600-v, capacities up to 100,000-rms symmetrical amp, is featured in 8-p well-illustrated bulletin 100 available from Pennsylvania Transformer Div of McGraw-Edison Company

173 **Die-stamped circuits** are topic of 12-p booklet D1 covering how circuits are made, their features. Dytronics, Inc

continued

Regenerating Water Softeners Efficiently:

Only one salt dissolver delivers fully saturated brine at lowest cost

It's the Sterling Lixator—a fully automatic rock salt dissolver developed exclusively by International Salt Company for making 100% saturated brine from economical Sterling Rock Salt. It's being used in hundreds of industrial and commercial water softener installations because of its simplicity, economy and trouble-free operation. Here are the Lixator's advantages:

Lixator has no moving parts—nothing to get out of order.

Downflow principle. After water is admitted into the Lixator, it flows *down* through the rock salt in the dissolving zone.

Brine is self-filtered for maximum purity. There is no sand or gravel filter bed to bother with. Instead, rock salt crystals in the lower portion of the Lixator completely filter the saturated brine.

Fully automatic. Whenever brine is drawn off, water is automatically admitted into the dissolving chamber to make more brine. Rock salt flows in from a Lixator hopper or down a chute from an overhead bin. The only requirement is to keep the storage section filled with Sterling Rock Salt.

Great flexibility. The Lixator can be placed anywhere, at a point most convenient for salt delivery. *Pipes* deliver brine to the softeners.

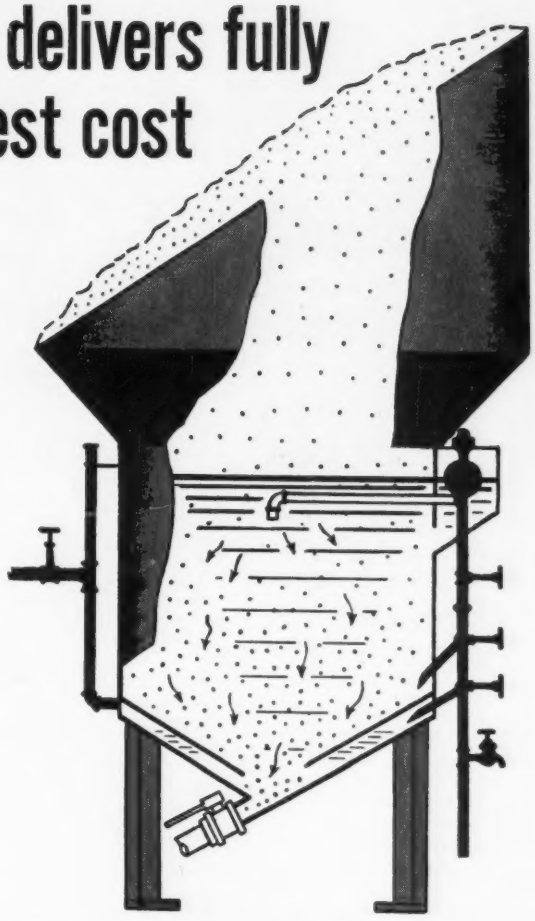
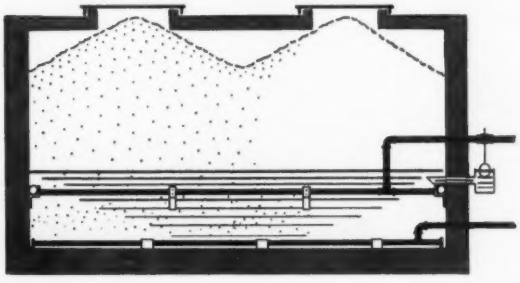


Diagram of Sterling Model Lixator. This is today's most widely used rock salt dissolver. It's available in many standard sizes—from 24″ to 120″ in diameter . . . with brine-making capacities up to 6,000 gallons per hour. Lixators come in enameled steel, Monel metal, or corrosion-proof plastic . . . with storage hoppers (standard low-lip, wall-type, cylindrical, corner, etc.) to suit any plant requirement.



▲ **Diagram of Sterling Storage Lixator.** Designed for larger operations, the Storage Lixator is a combination salt storage, salt dissolving, and brine storage tank. On delivery, Sterling Rock Salt is unloaded directly into the Lixator. Lixate Brine is made automatically, as it is in every type of Lixator.

For information on how your plant can save money with a Lixator, contact the nearest International Salt Company sales office. You can also get a free copy of "Brine for Today's Industry"—which fully describes the Lixate Process.

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INTERNATIONAL STERLING SALT SALT COMPANY

"A STEP AHEAD IN SALT TECHNOLOGY"

...on the

JOHNSON

HORIZONTAL

STEAM GENERATOR

The "good word" to pass is: The Economical, efficient, automatic source of constant pressure and uniform temperature steam of the Johnson Horizontal Steam Generator . . . Built to A. S. M. E. Specification in sizes up to 33 H.P. Check these features below to assure trouble-free service with the least possible Maintenance.

- Fuel—Gas, Oil or Combination Gas and Oil Firing.
- Design—Modern, Efficient.
- Construction—A. S. M. E. Standards.
- Inspection—Fully tested under the most rigid conditions.
- Standard Pressure—100 lbs.
- Extra High Pressure up to 250 lbs.
- Easy Adaptability—to boiler feed and return condensate units.

Free—for full details, send for Bulletin #8C and #4H.

"Engineered Steam at its best, with over 50 years of Experience at your disposal!"

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DIVISION OF S. T. JOHNSON CO.
Church Road, Bridgeport, Pa.

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Free literature

Begins on page 99A

174 **Trolley busway** distribution systems for heavy duty are cataloged in 32-p brochure 80. Systems for electrifying cranes, hoists, conveyor lines come in 225, 375 and 500 amp. Feedrail Corp

175 **Rotary switch,** hermetically sealed, is feature of bulletin D-460. Illustrates 3072 standard designs. Dimensions, mountings, receptacles and wiring are specified. Ledex Inc

176 **Wire and cable** insulated with silicone rubber are specified with data charts and graphs in booklet from Dow Corning Corp

177 **Snap-acting switches** for control and indicating circuits, firm's complete line, are described and illustrated in 32-p brochure 10-1. Dimension drawings, force and movement specs included. Unimax Switch Div of The W L Maxson Corp

● **Application**

178 **Electrical - product reference** guide shows most frequently ordered of firm's products. Info on variable transformers, voltage regulators, connectors, synchronous motors, reactors is included. The Superior Electric Company

179 **Motor windings** encapsulated with room-temperature-vulcanizing silicone rubber are explained in 4-p bulletin CDS-254 available from General Electric Company

180 **Electrical insulating oils** for transformers and cables are detailed in 8-p bulletin 58. Discusses oil requirements for different types of equipment. Sun Oil Company

181 **Synchronous motors** are featured in 8-p brochure giving technical characteristics, specs, ratings and outline dimensions of 50-, 150- and 250-oz-in. motors. The Superior Electric Company

182 **Induction motors,** squirrel-cage type with encapsulated stator, are described with specs tabulated in brochure 6100. The Lincoln Electric Company

183 **Insulating tape** for protecting silicone-rubber form-wound coils is detailed with specs in bulletin 205A available from Moxness Products, Inc

continued

"But I'm at Maximum CFM Now, Sahib!"

Why be a slave to antiquated, ineffectual equipment that delivers a lot of noise but little else? The new equipment available today to meet any ventilation problem will be on display at the Heating & Air-Conditioning Exposition. There, top executives, engineers and salesmen will provide you with helpful information and money-saving tips about the ventilation equipment in which you're interested.

More efficient methods of installation, use of related equipment, flexibility and adaptability of equipment are just some areas of their knowledge and experience from which you can profit.

Attending the exposition gives you the opportunity to confer, compare and evaluate the more than 500 displays of heating, refrigeration, air conditioning and ventilation systems, equipment and components.

Plan your visit now!

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Feb. 13-16, 1961

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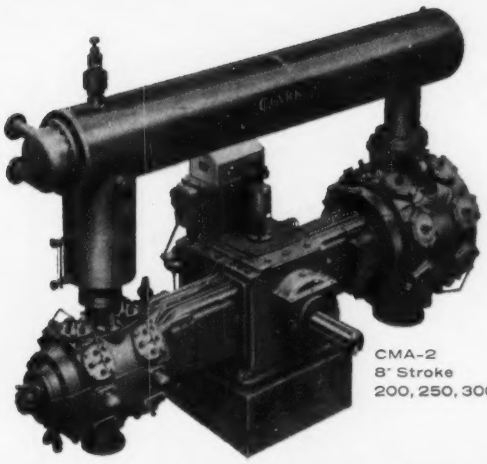
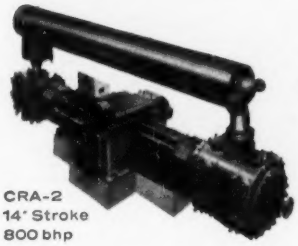
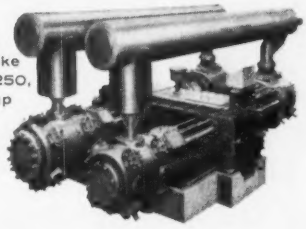


CMA-2
8" Stroke
200, 250, 300 bhp

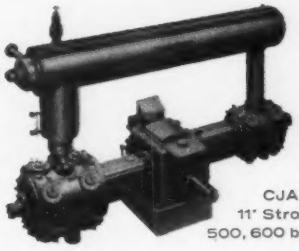
Whatever your requirements for industrial air,



CRA-2
14" Stroke
800 bhp

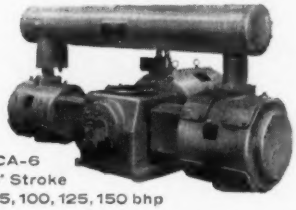


CRA-4
14" Stroke
1000, 1250,
1500 bhp

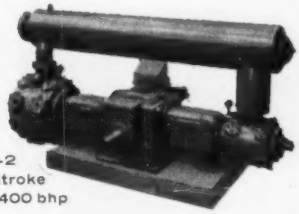


CJA-2
11" Stroke
500, 600 bhp

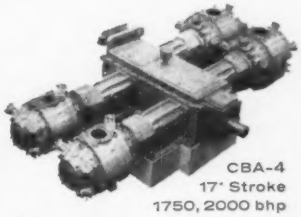
there's a Clark Balanced/Opposed Compressor



ICA-6
6" Stroke
75, 100, 125, 150 bhp



CMB-2
8¾" Stroke
350, 400 bhp



CBA-4
17" Stroke
1750, 2000 bhp

to do it better & more economically in less space.

Six Stroke Sizes...23 Models. The Balanced/Opposed design is only one of many innovations that have made Clark air compressors the most dependable in industry today. Rugged and compact, they are specifically designed to handle your "100 lb." air requirements most economically. ■ Born of exhaustive research and proved by millions of hours of service, Clark Balanced/Opposed Industrial Air Compressors are engineered for maximum performance and reliability. They come equipped with "Simplaire" Valves—the simplest air compressor valves in the industry . . . easy to put together, easy to take apart, and *easy on your maintenance budget*. From a comprehensive line of 23 models, you can pick the compressor that's *right* for your needs. Sizes from 75 to 2000 horsepower; capacities range upward from 375 cfm. ■ For all the reasons why you'll be dollars ahead with Clark compressors, contact your Clark representative today, or write for Bulletin 185, **Clark Bros. Co., Olean, N.Y.**

CLARK®
COMPRESSORS
ENGINES • GAS TURBINES

DI
DRESSER INDUSTRIES INC.
OIL • GAS • CHEMICAL
ELECTRONIC • INDUSTRIAL

ENGINES ■ COMPRESSORS ■ GAS TURBINES

Most complete stock of boiler tubing anywhere

•

Bent Tubes fast for any make or size of boiler

BOILER TUBE COMPANY OF AMERICA

McKEES ROCKS, PA. (Pittsburgh District) Federal 1-7750

For more facts circle 258 on Reader Service card, p 99

VIKING

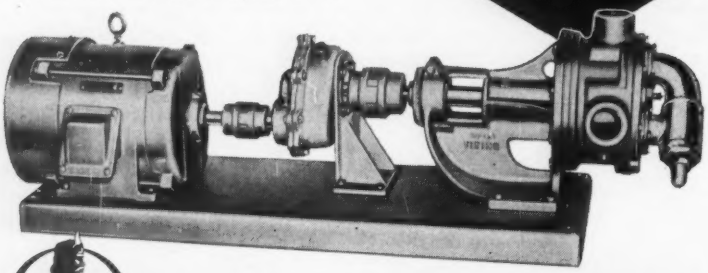
FUEL AND LUBE OIL PUMPS

All of the qualities you want for smooth, positive delivery of fuel oils, lube oils and other petroleum products are combined in the Viking 288 pump. It is compact, quiet, easily serviced, delivers 17 to 164 G.P.M. and more, under pressures up to 200 P.S.I.

This pump comes in 4 sizes, each with 5 gear reductions, making it extremely versatile to fit your every need. Send today for complete information on the Viking 288 pump!

17 to 164 G.P.M. • Compact • Positive Delivery • Quiet • 200 P.S.I.

Ask for catalog CW, page 27-28



50 YEARS

VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. • In Canada, It's "ROTO-KING" Pumps

See Our Catalog in Sweet's Industrial Construction and Plant Engineer's File

For more facts circle 259 on Reader Service card, p 99

Free literature

Begins on page 99A

184 **Lease plan** for lighting equipment is explained in 4-p brochure SA-8865. Westinghouse Electric Co

185 **Ac voltmeter** has specs, dimensions and prices outlined in 2-p bulletin GEZ-3254. General Electric Co

186 **Instrument - application** manual D-62 tells how to predict motor and electrical-equipment failure. Associated Research, Inc

187 **Squirrel-cage** induction motors with basic dripproof design are covered in 12-p booklet. Motors range from 1 to 150 hp. Century Electric Company

188 **Ac voltmeters** and ammeters are shown with features, specs and prices in 4-p bulletin GEZ-3109. General Electric Company

Energy-systems services

189 **Research,** development and production capabilities of firm are described and illustrated in 20-p brochure. Specification, specific fields of application and equipment company has produced are covered. Servo Corporation of America

190 **Dresden Station,** operating nuclear-power plant, is detailed in 12-p booklet GED-4275. Results of startup test program, future of large nuclear-power-generating stations are discussed. Charts, diagrams, photos included. General Electric Company

191 **Design- and consulting-**engineering services, valuation and property reports, depreciation studies, many other industrial services are detailed in book describing firm's services, capabilities. Pioneer Service & Engineering Co

EDITOR'S NOTE: *The following bulletins may be requested directly from the manufacturer*

★ **Semiconductor catalog** covers over 800 devices, gives ratings, characteristics and descriptive data on silicone-glass diodes; rectifier cells; h-v cartridges; silicon-controlled rectifiers; silicon solar cells. Write on company letterhead to International Rectifier Corp, El Segundo, Calif.

★ **Air conditioners** are topic of booklet CN 1-1960 giving cooling-load-estimate form. Definitions, rating standards and test procedures for room air conditioners are included. Available for 30c from National Electrical Manufacturers Association, 155 E 44th St, New York 17, N. Y.

continued

YARWAY Y news briefs

from **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD • STEAM TRAPS STOCKED AND SOLD BY 270 LOCAL INDUSTRIAL DISTRIBUTORS

THIS STEAM TRAP WILL DISCHARGE 25,500 LBS. OF CONDENSATE PER HOUR

This is a typical installation of a Yarway Series 40 Impulse Steam Trap—a trap designed specifically to gobble up extra heavy condensate loads.

The trap is a No. 48, 2½" size, and is installed on a suction heater connected with an 86,000 barrel tank containing fuel oil at a storage terminal. The operating pressure is 13 psi. At this pressure the trap has a capacity of 25,500 lbs. continuous discharge of condensate per hour.

At operating pressure of 100 psi, the trap's capacity is 62,000 lbs. per hour.

CAPACITY—PLUS

Capacity isn't the whole story on Yarway Series 40 Steam Traps. Like all Yarway Impulse Traps, they offer advantages like quick heat-up, even temperatures, small size, good for all pressures, non-freezing.

Series 40 traps also feature high temperature discharge characteristics, excellent low pressure operation, no airbinding, operation against back pressures up to 40%, and stainless steel construction.

You can get Yarway's latest steam trap Bulletin T-1743, or arrange for a free 60-day trial of a Yarway Impulse Trap, by writing to Yarnall-Waring Company or contacting your local Industrial Distributor.

Yarway ½" No. 40 Impulse Steam Trap (shown actual size). Also available in ¾", 1½", 2" and 2½" sizes.

YARWAY OFFERS IMPULSE STEAM TRAPS FOR THESE SPECIFIC OPERATING CONDITIONS

AVERAGE CONDENSATE LOADS	EXTRA HEAVY CONDENSATE LOADS	LIGHT CONDENSATE LOADS
Series 60	Series 40	No. 30

For more facts circle 260 on Reader Service card, p 99

ROTO Hand-hole Seat Scraper

Roto Hand-hole Seat Scraper for B & W Boiler.

Eliminates tedious labor

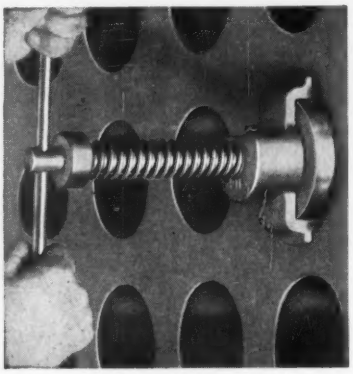
Assures clean, tight fit

Roto Hand-hole Seat Scraper makes short work of cleaning dirty hand-hole seats. This simple, hand-operated tool has adjustable, spring-mounted retractable knives. A few turns to the right remove foreign matter without cutting the metal. A half turn to the left releases the tool, and the job is done. Customers say that the Roto Seat Scraper does the job up to 12 times faster than by any other method. Try one and you'll wonder how you ever got along without it. *Send for details.*

Now available

for most hand-hole shapes and sizes

Standard Roto Seat Scrapers are available for the following equipment. Special types made to order.



Illustrating ease of operation of Roto Hand-hole Seat Scraper.

Type of Boiler	Opening	Tube Size
Babcock & Wilcox # 4	Round	2"
" " " #41	Oval	2"
" " " #70	Round	3"
" " " #48	Oval	3½"
" " " #40	Oval	3¼"
" " " #24	Oval	4"
" " "	Oblong	4"
Bros	Round	3¼"
Casey Hedges	Oval	3½"
" "	Oval	4"
Combustion Eng'rg	Round	3"
" "	Oval	3"
Edgemoor	Oval	4"
Erie City	Ellip	2½"
" "	Oblong	3¼"
" "	Ellip	3¼"
" "	Pear	4"
Foster Wheeler	Oblong	2½"
" "	Oblong	3"
" "	Ellip	4"
Geary	Oblong	4"

Type of Boiler	Opening	Tube Size
Heine	Round	3½"
"	Oval	3½"
International Boiler 2	Oblong	3"
Keeler	Round	3½"
"	Round	4"
"	Diamond	3½"
"	Diamond	4"
Lasker	Oblong	
Murray	Oval	3½"
"	Oblong	4"
Oil City	Oval	3½"
" "	Oblong	4"
Riley Stoker	Ellip	3¼"
Springfield	Ellip	3¼"
Union Iron Works	Pear	4"
Henry Vogt	Ellip	3¼"
" "	Oval	4"
Walsh & Weidner	Oval	4"
Wickes	Ellip	2½"
"	Ellip	3¼"
"	Pear	4"
"	Round	4"

ELLIOTT COMPANY – ROTO PLANT

Tube Cleaner Specialists Since 1910

153 Sussex Avenue, Newark, N. J.

For more facts circle 261 on Reader Service card, p 99

Free literature

Begins on page 99A

★ **Standard 511** (Air-Conditioning and Refrigeration Institute) for ammonia compressors and compressor units replaces Standards 5 to 12. Available for 50c. Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave NW, Washington 6, D.C.

★ **Refrigerant-12** and Refrigerant-22 compressors and condensing units, 25 hp and larger, is topic of Air-Conditioning and Refrigeration Institute Standard 516. Available for 50c, 516 replaces Standards 5 to 21. Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave NW, Washington 6, D.C.

★ **Hydraulic products** are topics of three catalog sections featuring tubing, fittings, hose. Features, applications, specs, ordering info are detailed. Formite Tube Company, Two Rivers, Wis.

★ **Hp ratings** for roller chains issued by Association of Roller and Silent Chain Manufacturers suggest expanded application field for roller chain drives, more hp per chain dollar. Roller impact forces, dynamic tension forces, efficiency and wear life are discussed. Price: $1.00. Association of Roller and Silent Chain Manufacturers, Uptown Station, P.O. Box 55247, Indianapolis 5, Ind.

★ **Safety-relief-valve** catalog 301 has 100 pp, illustrates and describes firm's complete line. Capacity charts and tables, valve service index, maintenance-equipment details, guide to corrosion-resistant properties aid selection, explain applications. Crosby-Ashton, 8 Kendrick St, Wrentham, Mass.

"Mom, the man wants his pressure cooker back."

SEL-REX RECTIFIERS HELP PUT GOOD LOOKS AND DEPENDABILITY INTO BUSY TALON ZIPPERS!

Sadler's Wells Ballet, now the Royal Ballet, as it appeared on NBC-TV

Ballerinas know, as do women everywhere, that confidence is difficult to measure. For, it often rests on little things—from a dab of makeup to the dependability of a zipper. Engineers know it too... knowledge acquired from years of strict attention to detail. Typical is the confidence of Talon engineers, men who build amazing dependability into every Talon fastener.

Talon, Inc. engineers have chosen Sel-Rex Selenium Rectifiers and Sel-Rex Remote Control Units to supply and to control the D.C. needed in their metal finishing departments. These Sel-Rex units provide the power for nickel plating, copper plating and zinc barrel plating —where superior quality depends upon precise current and its control.

According to Robert E. Hammer, Manager Plant 7, Talon, Inc., Meadville, Pa., "We rely on these units not only for minimum maintenance requirements but also for the exacting power control necessary to maintain our high quality standards."

If a dependable source of D.C. is among *your* plant requirements, join the thousands of experienced and *confident* engineers who have chosen Sel-Rex Rectifiers as their source of trouble-free power.

Complete Semi-Conductor Power Conversion Equipment and Systems for any AC to DC Application

Send for Free "GUIDE" to Industrial Rectifier Equipment

SINCE MEAKER 1899

THE MEAKER COMPANY

SUBSIDIARY OF SEL-REX CORPORATION

Nutley 10, New Jersey

Factories and offices Chicago 50, Ill., Los Angeles, Cal. and Nutley 10, N. J.

Representatives in principal cities.

For more facts circle 262 on Reader Service card, p 99

For more data on these developments, circle key numbers on Reader Service card, p 99

Plant equipment news . . . Your

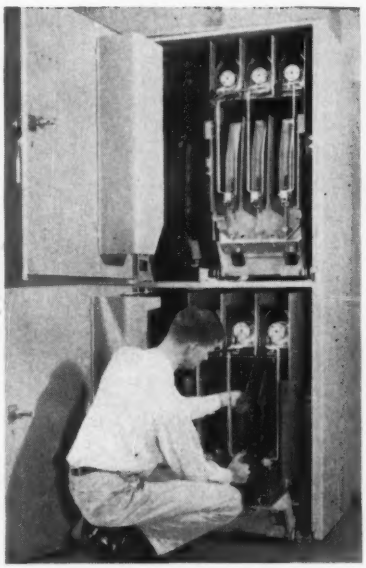
Compact double-decker h-v control features air-break contactor

1 • H-v motor control for 2000- to 5000-v range is two "stories" high—one controller mounts on top of the other. Each has a full rating of up to 1750-hp maximum at 2300 v or 3000-hp maximum at 4000 to 5000 v; each has interrupting capacity of 150 mva at 2300 v or 250 mva at 4000 to 5000 v with current-limiting fuses.

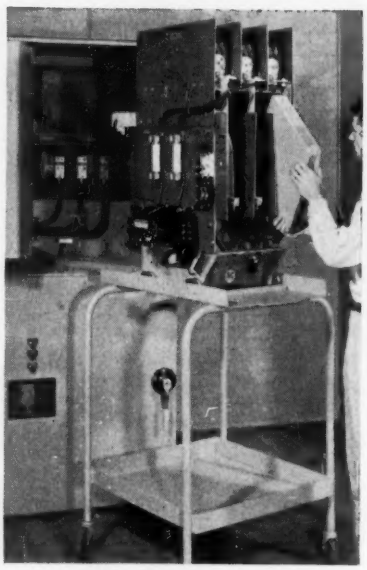
Reasons behind this design innovation: heart of the equipment, an air-break contactor, uses new glass-polyester insulations replacing sheet metal wherever possible. Superior insulating characteristics allow reduced space requirements, give operating benefits, according to maker.

Insulation cuts size of contactor rated 400 amp, 5 kv, 50 mva to only 28 X 16 X 24 in. According to maker, insulation is flame-retardant and nontracking, should extend control's life.

Inspection is easy. Drawout feature is a wheeled carriage that carries contactor, main fuses in their supports, main disconnecting fingers, control transformers and control-transformer primary and secondary fuses and 2-pole double-throw test-circuit switch. Wheeled dolly is provided to receive upper contactor carriage. A safety feature: overload relays are reset by buttons on front door; door cannot be opened until contactor carriage is in racked-out position.—Allis-Chalmers Manufacturing Company



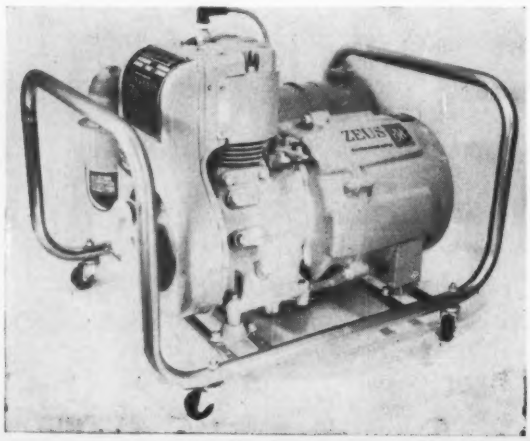
DOUBLE-DECKER UNIT with both doors open shows racked-out position. In this position bus-isolating shutters are closed



ARC CHUTES lift out easily to expose contacts for quick inspection. Door must be closed to rack in contactor

Interrupter switch for l-v feeders uses dual-element fuses

2 • Fused switch is designed to use current-limiting and overload characteristics of dual-element fuses for l-v feeders with fault capabilities up to 100,000-amp symmetrical. Maker says you get full fault protection economically on feeders with relatively low continuous-current ratings, high short-circuit current. Switch does not depend on intricate mechanisms for fault clearance, should give dependable operation even under unfavorable conditions. Rating has been fully tested.—Pennsylvania Transformer Div of McGraw-Edison Co



Portable generator produces 3000 w

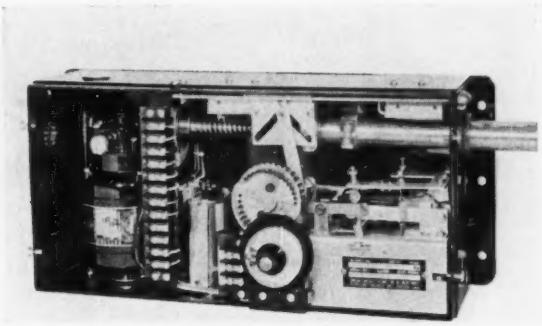
3 • Heavy-duty electric generator brings packaged power on the job or in remote locations. Generator's secret is a permanent magnet alternator. Magnet's rotating field generates electric power with no brushes, slip rings or commutator. Permanent magnet is internally fan-cooled, corrosion-protected, connects directly to engine shaft with no coupling. There are no power-wasting belts.

Lightweight portable qualities make package ideal for supplying prime or emergency power. Rating: 115-to-230 v, 60 cycle, single phase. Unit is powered by gasoline engine.—Borg-Warner Corporation

information center for new products and materials

Caliper attachment lets ultrasonic instrument measure thickness

4 • Ultrasonic flaw detector measures thickness of metals and plastics *from one side* to accuracies within 0.010 in. Caliper attachment is essentially a fixed, scribed, vertical line with second line on a slider moving across face of cathode ray. Synchronized dial indicator measures amount of this motion—thickness is measured directly without calculation or interpolation. You can also locate hidden discontinuities, voids and slag inclusions, determine their depths.—Branson Instruments, Inc



Flow regulator has built-in field-adjustable cam

5 • Regulator's characterizing cam eliminates need for expensive, troublesome characterized oil or gas valves. You can characterize cam simply by turning a series of Allen-head screws, adjust any point on the cam or readjust to original setting at any time, unlike filing cams.

Unit senses changes in air flow and drives its own actuator. Use to proportion fuel and air for metered control in combination gas-oil fired boilers. Single unit will monitor either fuel.—Cleveland Controls, Inc

Gage is for polar, tropic temperatures

6 • Temperature-compensated test gage is said to hold high degree of accuracy in wide temperature range. You can use it as a portable test instrument.

Temperature compensation is built into both bourdon-tube and linkage. Bourdon tube is made of high nickel alloy to minimize effect of temperature on spring rate. Adjustable link corrects zero shift error.—United States Gauge Div of American Machine & Metals, Inc

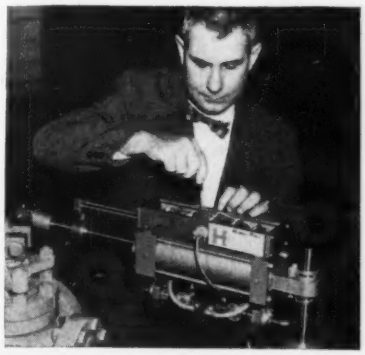
Position indicator sees 10-ft fluid level

7 • Indicator gives continuous meter reading up to ten ft of mechanical travel or fluid flow. Traveler or float rides along probe. Probe mounts directly or remotely to direct-reading receiver. Follower within probe is magnetically coupled with moving traveler to shunt out part of a resistive circuit. Receiver meter connects to this circuit. Use for any mechanical device having a linear motion or to operate remote indicators.—The Gems Company, Inc

Control automatically positions valves

8 • Electrical-mechanical multiple positioner acts like control-selector-switch signal. Use to automatically position valves, float levels, doors, etc. By turning or pressing the selector control switch in pipeline control offices, you can open or close a valve at several selected positions which may be miles from the office. Return-readout-signal light indicates when the predetermined position of the pipeline valve is reached.

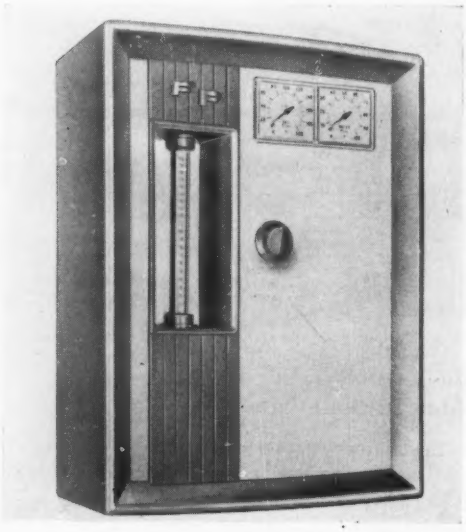
Unit has two cam rods. Connecting link on one rod end is attached to mechanism the positioner is controlling. Other ends of rods trip limit switches as cam rods slide back and forth inside grooves in positioner's aluminum housing. Adjustments are made by loosening two screws and moving switches. Engineer, right, adjusts limit switches to change position stops. —Hanna Engineering Works



For more data on these developments, circle key numbers on Reader Service card, p 99

More **equipment news**

For more data on these developments, circle key numbers on Reader Service card, p 99

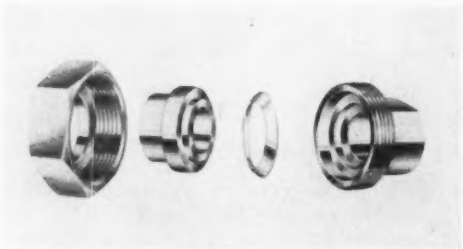


Wall-mounted chlorinator, simply designed, houses all controls

9 • Chlorinator for industrial water and waste-treatment facilites features a safety stack regulator which houses all control components. Design is simple—there's no frail piping or connections, potential leak sources.

When unit isn't operating, shutoff valve seals chlorine supply; isolating valve seals moving parts—not even traces of water can enter chlorinator from ejector back-pressure, says maker. Pressure regulator keeps chlorine gas feed stable despite variations.

Manually operated chlorinator keeps an accuracy of ±2% feed rate over 20-to-1 range in flow. Simple snap-in flowmeter tube allows capacity changes from 3- to 200-lb chlorine gas per day—no need for extra tools. Chlorinator is housed in rigid fiberglass cabinet.—Fischer & Porter Company



Fitting for small-diameter tube and pipe

10 • Fitting should withstand extreme low or high temperatures and high pressures or vacuum where leak-proof sealing is a requirement. You can apply stainless-steel fitting from –450 to +1500 F, or at pressures to 16,000 psig on critical pneumatic, hydraulic, fuel, cooling, heat-transfer and pressure or vacuum lines. Use as transition joint.—Marman Div of Aeroquip Corp

High-capacity separator purifies lube oils

11 • Apply unit to separate liquid from liquid, solids from liquid. It can separate sea water, solids and other contaminants at rate of 12,000 gph.

Operation is based on principle that oil is lighter than water and solid wastes. Purifier bowl spins at 4100 rpm separating water and solids by centrifugal action. When oil leaves purifier by one exit, water is discharged from another exit carrying some solids with it. Bowl retains remaining solids in holding space with capacity of over 60 lb. Unit is adapted from firm's disk type centrifuge.—De Laval Separator Co

Silica analyzer measures boiler feedwater continuously

12 • Analyzer detects silica contents in boiler feedwater down to 0.2 ppm. Every 12 minutes, unit automatically takes measured water samples. Solenoid valves operated by a mechanical programer initiate fixed volume of molybdate solution and reducing agent as 3-min introduction. Nine minutes of stirring and reducing in reaction vessel follow, then blue-tinted solution is produced for optical comparator. Twin photocells compare sample with reference filter. Cells' differential output feeds amplifier which drives pen recorder.—Electronic Instruments Ltd

Self-cleaning steam condenser ends downtime

13 • Condenser eliminates downtime for condenser-tube and tube-sheet cleaning where circulating water is polluted by trash, leaves, algae, silt or other foreign matter. Design feature: reversing mechanism is within condenser itself.

Hydraulic cylinder actuates valves or sluice gates without vacuum loss, according to manufacturer. Flow may be reversed at full load.

Units come in either single- or divided-waterbox designs with variations to suit installation. Materials are corrosion and abrasion resistant.—C H Wheeler Mfg Co

For more data on these developments, circle key numbers on Reader Service card, p 99

PRATT POWER PLANT PRODUCTS are all NEW for the '60's

NEW Rubber Seat Butterfly Valves

The time-proven Henry Pratt features are now augmented by such new design features as: ADJUSTABLE SEAT that can be tightened, or even replaced without removing shaft or disc. LOWER SEATING TORQUES, lowers actuator cost and provides remarkable ease of operation. Longer operating life through accurate control of disc-seat interference, giving tightness, without wear.

The new Pratt Butterfly Valves are available in sizes 3" through 144" and for pressures to 150# in both wide and narrow face-to-face. Also furnished with integral expansion joint.

Write for complete information.

NEW PRATT CYCLONE STRAINER

The new Pratt Cyclone Strainer eliminates the manual cleaning usually associated with this type of equipment. Backwashing operations are completely automatic and can be accomplished in seconds.

Unique design simplifies piping and installs for *far* less than ordinary designs.

Patented "Cyclone" action keeps larger particles away from basket—keeps strainer "on the line" longer.

Features rubber seat butterfly valves for longer life and positive action. Manual or automatic valve operators.

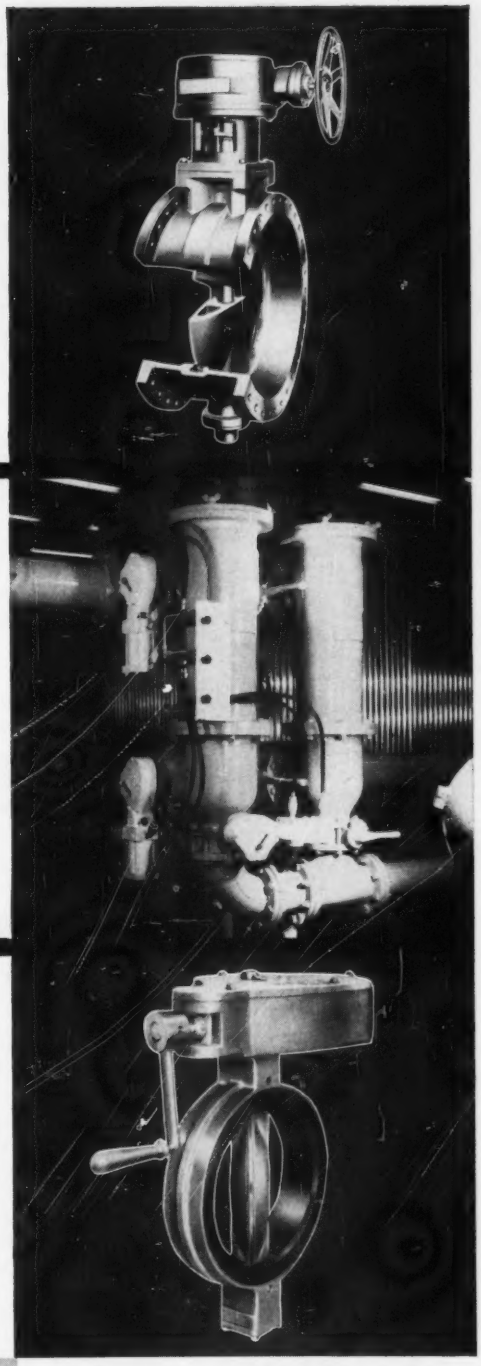
Write for bulletin S-1-K.

NEW Monoflange Mark -II

No valve is easier to install or operate. The Monoflange fits between existing pipe flanges—no gasket is necessary. With completely tight shut-off at 150# psi, the Monoflange Mark II finds many applications where economy is paramount, but long life is necessary.

New "Sidewinder" manual operators are available for standard or buried service with crank, handwheel or chainwheel. Cylinder, Diaphragm topworks or electric motor operators also available.

Write for Bulletin B-10-K.



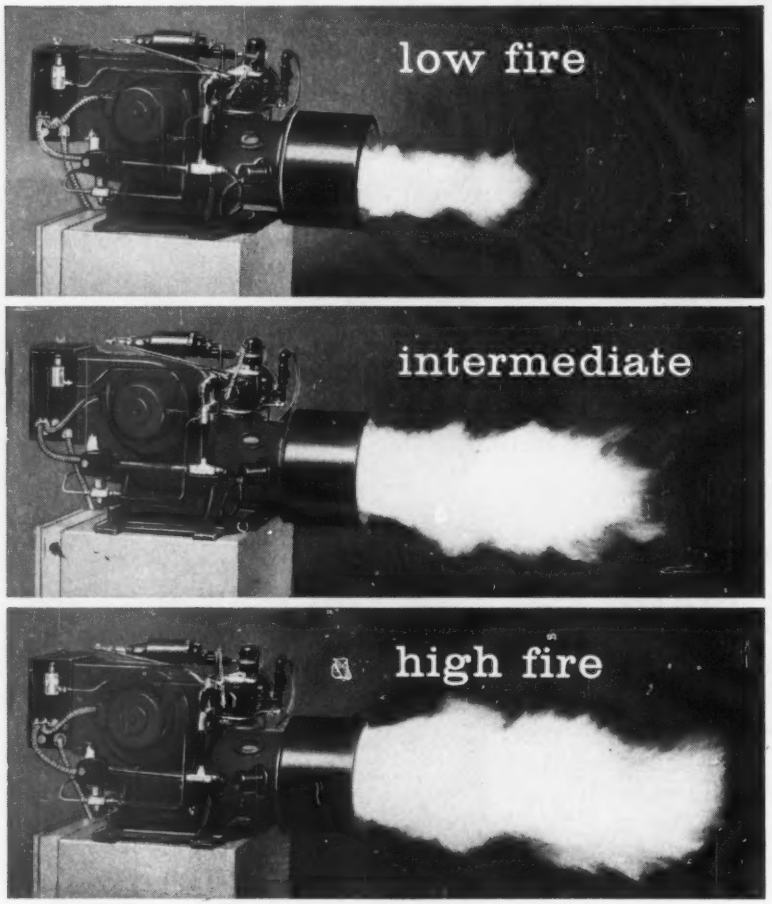
HENRY PRATT®

Creative Engineering for Fluid Systems

HENRY PRATT COMPANY
319 W. Van Buren Street, Chicago 7, Illinois
Representatives in Principal Cities

For more facts circle 263 on Reader Service card, p 99

Burner does a slow burn



for smooth, economical operation

HEV-E-OIL BURNERS start with a low fire, a small flame which gradually builds up to the required size for safe, smooth operation. Low fire and high fire are controlled exactly to assure top efficiency over the entire firing range. Moreover, Hev-E-Oil burners furnish all the primary and secondary air needed for efficient combustion.

Available from 5 to 150 gph. Also combination gas/oil burners from 720,000 to 21,000,000 Btu.

HEV-E-DUTY POWER GAS BURNERS also utilize slow fire build-up for top performance. Air is metered in correct proportion to the amount of gas being used, resulting in high efficiency regardless of chimney draft caused by outside weather conditions.

Sizes from 720,000 to 21,000,000 Btu. For more information on Hev-E-Duty Power Gas, Hev-E-Oil and combination burners, write Dept. P-11.

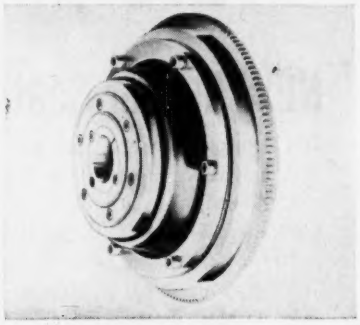
INDUSTRIAL COMBUSTION INC.

EXECUTIVE OFFICE: 4507 N. OAKLAND AVENUE
MILWAUKEE 11, WISCONSIN

For more facts circle 264 on Reader Service card, p 99

Equipment news

Begins on page 112

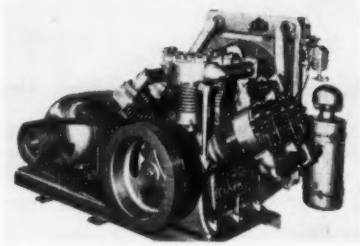


High-speed flexible cushion couplings

63 • Pan-shaped rubber flexing element is feature of newly designed cushion type couplings. Applications are for high-speed high-torque needs.

Designed for speeds up to 5230 rpm, coupling may be used with electric motors or internal-combustion engines to operate compressors, pumps, high-speed fans and blowers. They are also efficient on low-speed applications where torque requirements are high.—Dodge Manufacturing Corp

Just circle key numbers on the Reader Service card, page 99, to get complete product story



100-lb air compressors have 25- to 100-hp range

27 • Air-cooled 2-stage units are compact and efficient, maker claims. Extra weight, water-jacketing expense, cooling-water needs are ended. Built in 25-, 50-, 75- and 100-bhp sizes, units come as basic compressor, base-mounted without motor or base-mounted package with electric-motor drive.—Clark Bros Co

continued

Public Service Electric and Gas Co. Turns Fly Ash Problems Into Profit

By using Fuller pneumatic conveying systems, the Sewaren Generating Station of Public Service Electric and Gas Company, New Jersey, was able to collect 4100 tons of fly ash during 1957. Not only did this eliminate a serious disposal problem that formerly contributed heavily to operating costs . . . it also gave the utility which sold the collected fly ash, a new and valuable source of income.

The Fuller-Kinyon system at Sewaren collects and carries the fly ash to two storage silos that have a combined capacity of 380 tons. It is then either bagged in 50-lb. lots or transferred in bulk through a Fuller loading-out silo spout to tank trucks or covered dump trucks. Labor and equipment costs are kept at a minimum. Dusting is avoided, and high tonnages are handled easily over considerable distances. Extra handling flexibility is provided by a Fuller two-way diverting valve that permits unsuitable fly ash to be pumped directly to an ash reject tank instead of to storage.

Fuller pneumatic conveying systems can be installed almost anywhere at minimum costs, regardless of plant conditions. Moisture and dirt cannot enter the system and material cannot escape. Write today for detailed information in Bulletin FF-49-1. 1334 G-202

For full details and specifications, see Chemical Engineering Catalog.

Fuller
pioneers in harnessing AIR

FULLER COMPANY
126 Bridge St., Catasauqua, Pa.
Subsidiary of General American Transportation Corporation
Birmingham • Chicago • Kansas City • Los Angeles • New York • San Francisco • Seattle

FULLER COMPANY GENERAL AMERICAN TRADE MARK

For more facts circle 265 on Reader Service card, p 99

Name Your Application!

Do It Better With *ThermoElectric* *Thermocouple Extension Cables and Wires*

You can obtain Thermo Electric thermocouple extension wire and cable in the widest variety of size, insulation, type and calibration, for your application—with prompt delivery of all standard materials.

New on the stock list, is the time and labor saving "Thermo-Cable," from 6 to 56 matched pairs of I.S.A. color-coded thermocouple leads, individually insulated in PVC—collectively wrapped in "Mylar" tape—with a tight-fitting PVC outer sheath. "Thermo-Cable" is practically impervious to moisture, abrasion, temperature, gases and chemicals. Saves you the time, cost and effort of pulling individual wires through conduit.

Individual or duplex thermocouple and extension wires are available in all standard calibrations—many in gages from 14 to 40—insulated with Polyvinyl Chloride, cotton lacquer, Nylon, Teflon, Fiberglass, Asbestos or combinations of these materials. Metallic overbraids of stainless steel and other high-temperature materials provide extra mechanical protection and shielding.

"Ceramo", Thermo Electric's metal-sheathed ceramic insulated thermocouple wire is used for extra-high temperature and nuclear applications.

Thermo-Electric also supplies thermocouple wires to meet Mil-Spec requirements.

For information on selecting the right wire for your application,

write today for Bulletin 32-W5-42

Thermo Electric CO., INC.
SADDLE BROOK, NEW JERSEY

In Canada: THERMO ELECTRIC (Canada) LTD., Brampton, Ont.

For more facts circle 266 on Reader Service card, p 99

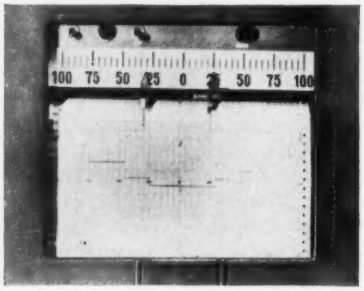
Equipment news

Begins on page 112

Generator gives high and low frequencies

20 • Unit will produce power at frequencies from 250 to 450 kc and from 1 to 7 mc at the flick of a selector switch. All controls are built in, operated externally. Coils and fixtures mount in front to connect to outputs—no additional cabinets are needed. Generator will solder, braze, anneal and harden. Variable-output transformer, adjustable tank are housed in dust-tight cabinet.—Induction Heating Corp

Just circle key numbers on the Reader Service card, page 99, to get complete product story

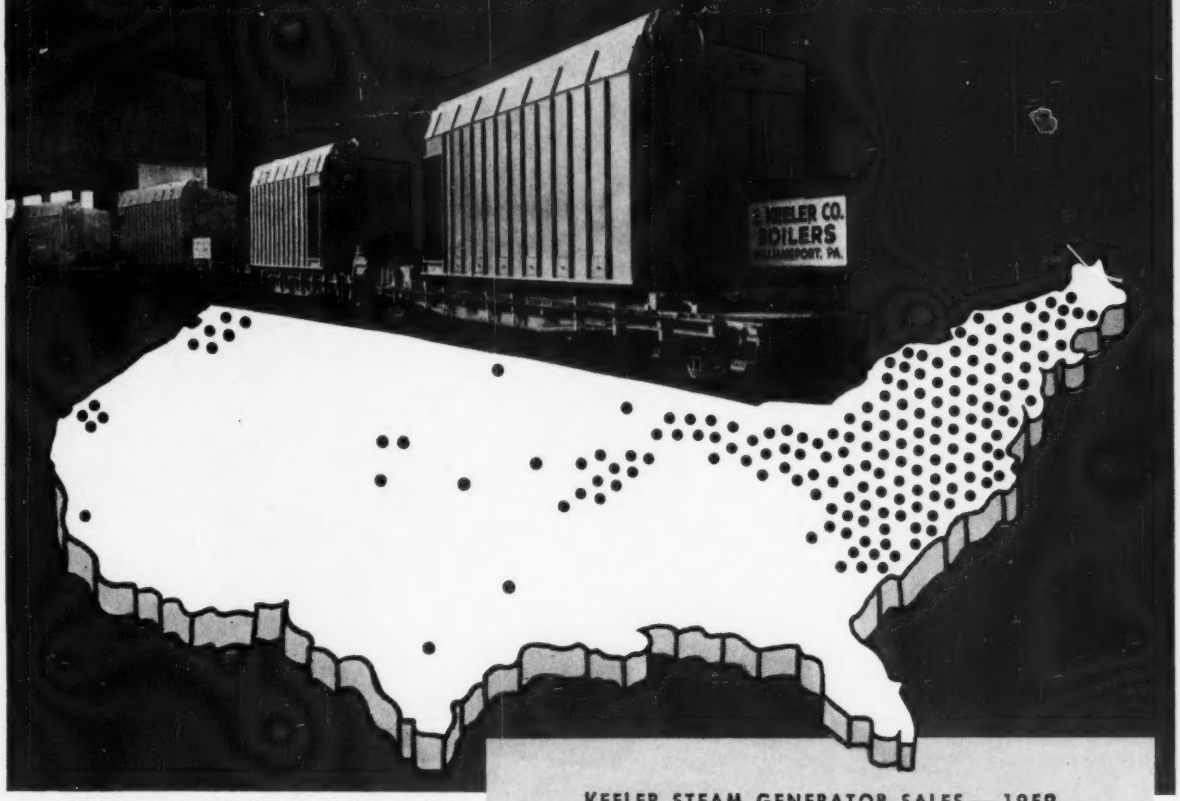


Strip-chart recorders feature null balance

23 • 1- and 2-pen recorders use null-balance principle for measuring. This principle compares output of an external - linear - variable differential transformer with a signal derived from an internal transformer. Both are l-v distribution type. The position of balance system is indicated by pen on chart.

continued

in 1959 alone, KEELER supplied
OVER FOUR MILLION LBS/HR
NEW STEAM CAPACITY THROUGHOUT THE NATION



A MILLION POUNDS/HOUR MORE STEAM CAPACITY THAN THE YEAR BEFORE

Each dot on the map represents a new Keeler Steam Generator sold during 1959. The group included units for all fuels, all types of firing—for power, process, heat and special steam needs. Total capacity was over 4 million lb/hr—a 1 million lb/hr increase over the previous year.

Yes, Keeler is one of the nation's leading manufacturers of steam generators — from low cost package units up to 100,000 lb/hr and field erected units up to 200,000 lb/hr. *Write for full data* . . . nearly a century of versatility, economy, dependability and experience are yours when you specify and insist upon Keeler quality for your steam requirements.

E. KEELER COMPANY
200-300 West St. · Williamsport, Penna.

—OFFICES IN PRINCIPAL CITIES —
In Canada: Canadian Vickers, Ltd., Montreal, P. Q.

ESTABLISHED 1864

The Seal of Quality in Water Tube Steam Generators

KEELER WATER TUBE Boilers

KEELER STEAM GENERATOR SALES — 1959

*Indicates more than one unit

ALTOONA SCHOOL DISTRICT
AMITY DYEING & FIN. CO.
ANDERSON MEM. HOSPITAL*
ANDREWS AIR FORCE BASE, John H. Towers Field*
ATLAS WAREHOUSE & COLD STORAGE COMPANY

BETHLEHEM STEEL CO.*
BOYS INDUSTRIAL SCHOOL
BRAMBLE CANNING CO.*
BUNKER HILL A.F. BASE
BZURA, INC.*

CARSON PECK MEM. HOSP.*
CENTRAL INTEL. AGCY.*
CHARLESTON GENL. HOSP.*
CHARLOTTE MEM. HOSP.*
CHRISTIAN COLLEGE*
CIRCLE WIRE & CABLE CO.
CONTINENTAL CAN CO.*
CORLIN PROCESSING CO.
CORNELL DUBILIER ELEC.
COTTAGE HOSPITAL
CRUNDEN MARTIN MFG. CO.*
CURTIS PAPER COMPANY

DARST APARTMENTS
DOVER GENERAL HOSPITAL
DRESDEN NUCLEAR POWER STATION*
DUROX OF MINNESOTA

FAIRFAX COUNTY HOSPITAL*
FEDERAL CORRECT. INST.
FIBER INDUSTRIES, INC. *
FRANKFORT DEPT. of HEALTH

GENERAL ELECTRIC COMPANY
GENERAL REFRACTORIES CO.
GERMANTOWN HIGH SCHOOL*
GLOBE RUBBER COMPANY
GOOD SAMARITAN HOSPITAL
GOTTLIEB MEMORIAL HOSP.*
GREELEY CAPITOL PKG. CO.*
GROUP HEALTH HOSPITAL*

HAVERFORD MENTAL HEALTH CENTER*
HENRY HEYWOOD MEMORIAL HOSPITAL
THE HILL SCHOOL
HOWARD COUNTY HOSPITAL*

INGERSOLL RAND COMPANY
INREDECO, INC.*

KEASBY & MATTISON
KENNEDY & BRITT, INC.

LANSDALE TUBE COMPANY
LAFAYETTE COLLEGE*
LIGGETT & MYERS TOB. CO.*
A. LLOREDA & COMPANY
LOCK HAVEN HOSPITAL*

MADISON COLLEGE
MANCHESTER COLLEGE
MANDAN CREAMERY & PROD.
MD.-VA. MILK PRODUCTS
MASONIC HOME, Burlington
MASONIC HOME, Elizabethtown
MENDOTA STATE HOSPITAL
MERCER CO. HOME & HOSP.*
MERCY HOSPITAL, Brooklyn*
MERCY HOSPITAL, W-B *
MORGAN STATE COLLEGE*
MORNINGSTAR-PAISLEY, INC.
MT. ALOYSIUS JR. COLLEGE
MUSKINGUM COLLEGE

NORFOLK SOYBEAN PROCESSING PLANT
NU-METHOD DYEING & PROCESSING CO.

OHIO SOLDIERS & SAILORS ORPHANS HOME*
OUR LADY OF LOURDES HOSP.

PARMA COM. GENL. HOSP.*
PATUXENT INSTITUTION
S. B. PENICK CO., INC.
PENN DAIRIES, INC.
PHILCO CORPORATION
POTTSVILLE HOSPITAL
PUEBLO ORDNANCE DEPOT

RAYBESTOS MANHATTAN CO.
RAYWIN REALTY COMPANY
REED COLLEGE
RICHMOND-CHASE COMPANY
ROCHESTER & PITTSBURGH COAL COMPANY
JULIUS ROEHRS CO.
ROSS PUMPING STATION*
ROVEL REALTY CORP.

S & P LAUNDRY
ST. AGNES HOSPITAL*
ST. JOSEPH-HOSP., S. J., Mo.*
ST. JOSEPH'S HOSP., K.C.*
ST. JOSEPH'S MERCY HOSP.
ST. VINCENT'S HOSPITAL
SAN FRANCISCO HALL OF JUSTICE*
SEARS, ROEBUCK & CO.*
SHEPHERD NILES CRANE & HOIST COMPANY*
SIBLEY MEMORIAL HOSP.*
J. P. STEVENS & CO.
CHAS. G. SUMMERS, Jr., Inc.

TEXAS STATE OFFICE BLDG.
JOSEPH THOMAS FLORISTS
TITAN METAL MFG. CO.*

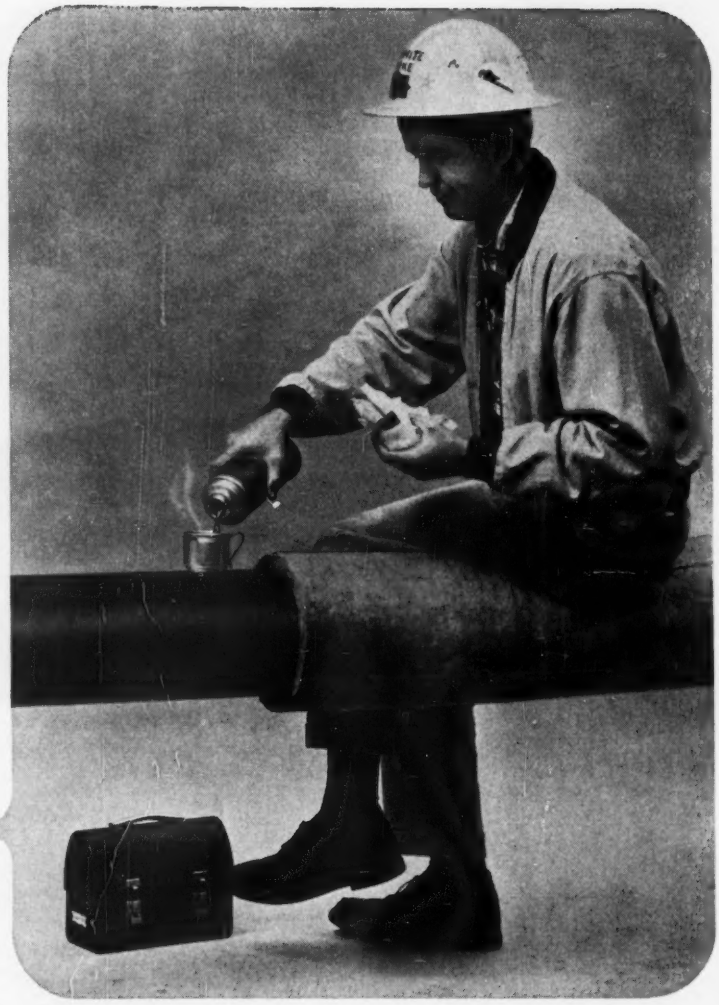
UNION CARBIDE CHEM. CORP.*
UNITED AIRLINES
UNITED PIECE DYE WKS.*
U. S. ARMY HOSP., Ft. Lee*
U. S. BUREAU OF PRISONS*
U. S. GYPSUM COMPANY
U. S. NAVY, Kingsley Field

VALLEY HOSPITAL*
VICKERS PETROLEUM CO., Inc.
VICTOR BALATA & TEXTILE BELTING COMPANY

WEST CHESTER S.T. COLLEGE
WESTERN PA. STATE SCHOOL & HOSPITAL*
WESTERN STATE HOSPITAL
WEST SEATTLE HIGH SCHOOL
WONDERKNIT CORPORATION

HERE'S WHY G-B SNAP*ON® GLASS FIBER PIPE INSULATION OUT-PERFORMS ALL OTHER PIPE COVERINGS

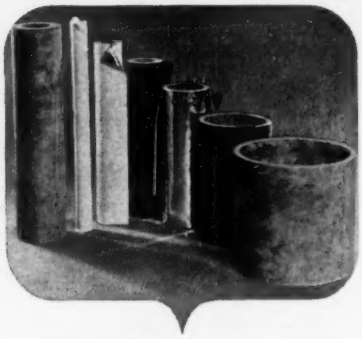
FOR CHILLED AND HEATED PIPE FROM SUB-ZERO TO 350° F.—INDOORS OR OUT— G-B SNAP*ON HAS NO SUPERIOR. AND HERE'S WHY:



HIGH IN THERMAL EFFICIENCY. A heated pipe may keep this workman's coffee hot, but it's a cinch that he won't get a "hot seat" when he's protected by G-B Snap*On. The "K" factors of this all-glass-fiber insulation are second to none among all general purpose pipe insulations.

IMMUNE TO DAMAGE. Tough to beat and tough to abuse — that's G-B Snap*On. There's just no knocking out the highly resilient glass fibers that go into the construction of G-B Snap*On. Even when accidentally crushed or stepped on, it springs back to its original shape.

EASY, FAST TO INSTALL. Thanks to its snap-hinge action, G-B Snap*On slips over pipe and snaps back to its original cylindrical shape in one easy motion. Once in place, G-B Snap*On provides permanent insulation protection. It does not rot, corrode, mildew or otherwise deteriorate.



VARIETY OF SIZES. The only one-piece glass fiber pipe insulation available in sizes over 32" IPS, G-B Snap*On is also available in diameters down to copper tubing . . . varying thicknesses . . . plain or with a variety of factory-applied facings for use indoors or out.

WRITE FOR COMPLETE PRODUCT INFORMATION

GUSTIN-BACON *Manufacturing Company* GUSTIN gb® BACON

242 W. 10th St., Kansas City, Missouri

For more facts circle 268 on Reader Service card, p 99

G-B SNAP*ON DISTRIBUTORS

LISTED IN YELLOW PAGES

AKRON, Ohio, The Asbestos Supply Co.
ALBANY, Ga., Industry Insulation Co.
ALBANY, N. Y., Hudson Valley Asbestos Corp.
ALBUQUERQUE, N. M., Mt. States Insulation Co.
AMARILLO, Tex., McDonald Engineering & Insulating Co.
ATLANTA, Ga., Reynolds Aluminum Supply Co.
AUSTIN, Tex., Cinbar Engineering Co.
BALTIMORE, Md., Leroy Insulation Co.
BANGOR, Me., Eastern Glass Co.
BATON ROUGE, La., Eagle Asbestos & Packing Co.
BEAUMONT, Tex., Coburn Supply Co., Inc.
BILLINGS, Mont., Big Horn Supply, Inc.
BIRMINGHAM, Ala., Reynolds Aluminum Supply Co.
Shook & Fletcher Supply Co.
BORGER, Tex., Western Chemical & Supply Co.
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BUFFALO, N. Y., Industrial Insulation Sales, Inc.
BURLINGTON, Vt., Pipe Insulators, Inc.
CHAMPAIGN, Ill., The Lewie-David Co.
CHARLESTON, S. C., Baker Bros., Inc.
CHARLESTON, W. Va., Asbestos & Insulating Co.
CHARLOTTE, N. C., D & B Insulation Co.
CHICAGO, Ill., E.C. Carlson Co.
Culberg Asbestos & Cork Co.
CHRISTOPHER, Ill., Hoe Supply Co.
CINCINNATI, Ohio, R. E. Kramig Co.
CLEVELAND, Ohio, Ohio Asbestos & Insulation Co.
COLUMBIA, S. C., Industrial Insulation Div. of Richland Oil Co.
COLUMBUS, Ohio, Santeler Brothers
Culberg of Ohio
CORPUS CHRISTI, Tex., Precision Insulation Co.
DALLAS, Tex., Acme Insulation & Supply Co.
DAVENPORT, Iowa., Republic Electric Co.
DAYTONA BEACH, Fla., B & F Insulation Co.
DECATUR, Ill., The Lewie-David Co.
DENVER, Colo., Plateau Supply Co.
Powers Industrial Insulation, Inc.
DES MOINES, Iowa, Iowa Asbestos Company, Inc.
DETROIT, Mich., The Walter Rankin Co.
ERIE, Pa., Laco-McMullen Co.
EVANSVILLE, Ind., Geo. Koch Sons, Inc.
FALCONER, N. Y., Laco Roofing
FT. SMITH, Ark., Gunn Distributing Co.
FT. WAYNE, Ind., M. H. Hilt, Inc.
FT. WORTH, Tex., Bracken Co.
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GREENSBORO, N. C., Starr Davis Co., Inc.
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INDIANAPOLIS, Ind., Lyon Lumber & Supply Co.
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JACKSONVILLE, Fla., Baker Bros., Inc.
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Reynolds Aluminum Supply Co.
JOPLIN, Mo., Joplin Cement Co.
KANSAS CITY, Mo., Central Supply Co.
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Kelley Asbestos Prod.
KEWANEE, Ill., Mechanical Insulation Co., Inc.
LAKE CHARLES, La., Coburn Supply Co., Inc.
Solar Supply Co.
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PORTLAND, Me., Eastern Glass Co.
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RAPID CITY, S. D., Robbins & Stearns Wholesale
RICHMOND, Va., Reynolds Aluminum Supply Co.
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SEATTLE, Wash., Western Fibrous Glass Products Co.
SHREVEPORT, La., Frith Sales Co.
SOMERVILLE, Mass., Insulation Products, Inc.
ST. LOUIS, Mo., Refrigeration Supplies, Inc.
The Stovey Company, Inc.
ST. PAUL, Minn., Asbestos Products, Inc.
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VALDOSTA, Ga., Baker Bros., Inc.
WASHINGTON, D. C., Walter E. Campbell Co., Inc.
WEST PALM BEACH, Fla., Southern Metal Prod.
WICHITA, Kans., General Metals, Inc.

S*O 11/30/60

Equipment news

Begins on page 112

Model MR2SL has two null-balance systems mounted side by side to record variables simultaneously, correlating events to a common time base.—Schaevitz Engineering

100-deg indicating instruments

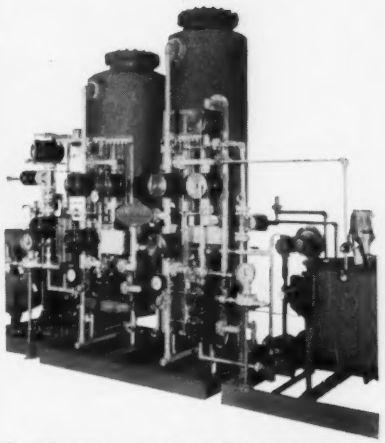
67 • Instruments for measuring dc volts and amperes use both taut-band suspension and core magnets. Ammeter measures from 20 microamperes to 50 amp, voltmeter from 35 mv to 800 v. Both instruments can be used in magnetic fields up to 500 gausses. Units use conventional jewel- and pivot-bearing system and horseshoe-magnet design. — Westinghouse Electric Corporation

Just circle key numbers on the Reader Service card, page 99, to get complete product story

Electronic vibration control

39 • Device protects equipment and processes against damage from excessive vibration. It is sensitive to 2-millionths-in. amplitude, manufacturer states. Described as a resonance type vibration monitor, it flashes signal or stops machine if vibration amplitude gets dangerous. Attachment turns it into a portable balancer to correct vibration. Feature: unit will pick out vibration

AUTOMATIC
DE-I*
ILLCO-WAY
DESIGNERS AND BUILDERS
MODERN EQUIPMENT FOR ionXchange



*DE-IONIZER

Here is a typical *fully-automatic* De-Ionizer, skid-mounted, loaded with resins, tested, ready for hook-up in your plant. A complete Control Panel (not shown), built by IWT, is included. Valves are exclusive ILLCO-MATIC, high-density polyethylene, specially designed for ionXchange service, pneumatically-operated, and *proved* reliable in extensive use.

FOR ANY PROCESS REQUIREMENT, OR HIGH-PRESSURE BOILER MAKE-UP

Such De-Ionizers are used to provide extremely pure water, tailored to specifications for all kinds of processes, or to the particular conditions for make-up of modern high-pressure boilers.

TELL US YOUR NEEDS

Our pioneering experience, gained since the very beginning of ion-exchange, is available for the successful solution of your water-treatment problems. Call your IWT representative.

ILLINOIS WATER TREATMENT CO.
840 CEDAR ST., ROCKFORD, ILLINOIS
NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Can.

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For modern Water Tube Boilers

Series 1500 Tube Expanders

. . . Recommended for use with Drum or with short Header Mandrels.

Right Angle Drive speeds-up rolling operation of any Tube inside round or square Header.

See your Dealer or write us for Bulletin.

The Gustav WIEDEKE Company

DAYTON 1, OHIO

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detect and continually record...

SILICA*

concentration down to 0.001 ppm

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A field-proven system . . . over 1500 AutoAnalyzers are now automating routine wet-chemistry analyses in plants and laboratories throughout the free world . . . analyzing up to 60 repetitive samples per hour and monitoring on-stream continuously.

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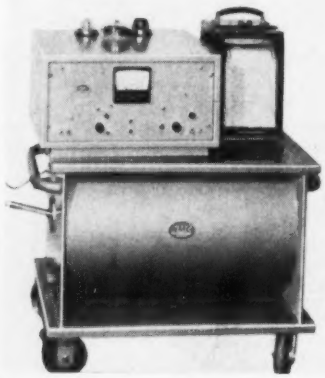
Send for your free abstract method kit and brochure AK8 today

TECHNICON CONTROLS, INC.

RESEARCH PARK • CHAUNCEY, N.Y.

For more facts circle 271 on Reader Service card, p 99

frequencies for which it has been set, filter out extraneous vibrations through mechanical resonance. Applications include gas-turbine engines, pumps, motors, fans, blowers. —Stewart-Warner Corp



Radiacitivity detector for gas or water

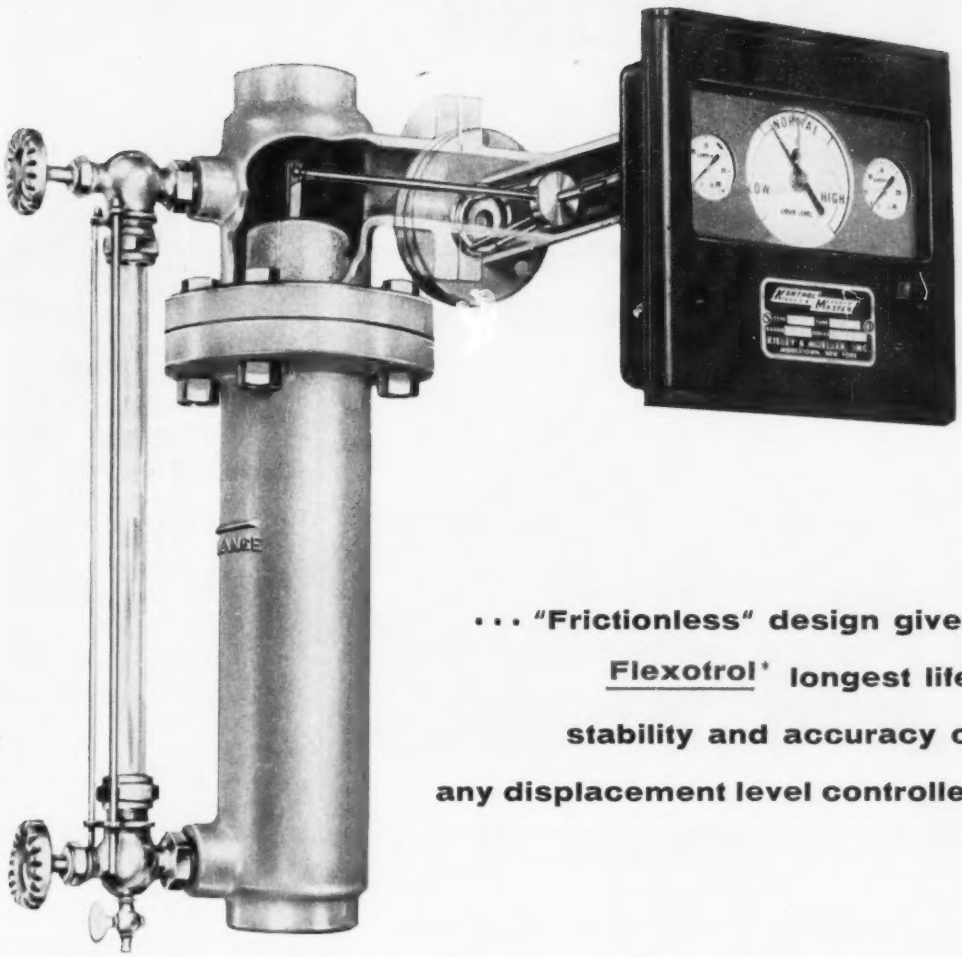
53 • Fluid-monitoring system has volume large enough for detection at maximum acceptable concentration levels, says manufacturer. You can use with alpha and beta-gamma air-particulate monitors. System measures activity of gaseous component of the discharge from these units. Motor blower assembly is available for completely independent operation.—Nuclear Measurements Corp

Just circle key numbers on the Reader Service card, page 99, to get complete product story

Multirange, portable dc voltmeter

24 • Instrument has analog-to-analog conversion system; tape-slidewire potentiometer with 144-in.-long resistance element is calibrated and geared to an in-line counter for readout accuracy to 0.1% in normal ambient temperature. According to maker, calibration is better than 1.05% and resolution better than 1.02%. Instrument is servodriven. —The Kotula Co, Inc

continued



. . . "Frictionless" design gives Flexotrol* longest life, stability and accuracy of any displacement level controller

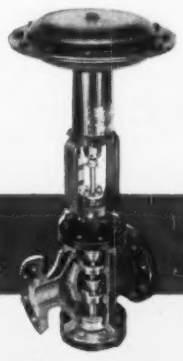
By avoiding knife edges, bearings and associated pressure-tight mechanical fittings, K & M has achieved almost frictionless operation in the *Flexotrol* Displacement-Type Liquid Level Controller. As a result, errors due to friction, distortion and hysteresis are practically nil.

Actuation is accomplished through a torque element which directly transfers displacer movement to the controller. There are no intermediate levers. Because the rotation of the tube is limited (4°) and because the whole assembly is constructed of high-durability materials, the torque system has remarkable fatigue resistance. Tests in excess of five million operating cycles have produced no detrimental fatigue effect.

The controller unit utilizes conventional 3-15 psi signal air pressure, has a 0-150% adjustable proportional band, may be direct-, reverse- or snap-acting without parts change. The *Flexotrol* Level Controller can also be converted to a transmitter-controller combination. Automatic reset and rate response are optionally available.

Full details are given in Bulletin 456-1. A copy is yours for the asking.

*Flexotrol is a trade-name of Kieley & Mueller, Inc.



K&M

diaphragm control valves

Our 80th Year

KIELEY & MUELLER, INCORPORATED

Oldest Pressure and Level Control Valve Manufacturer

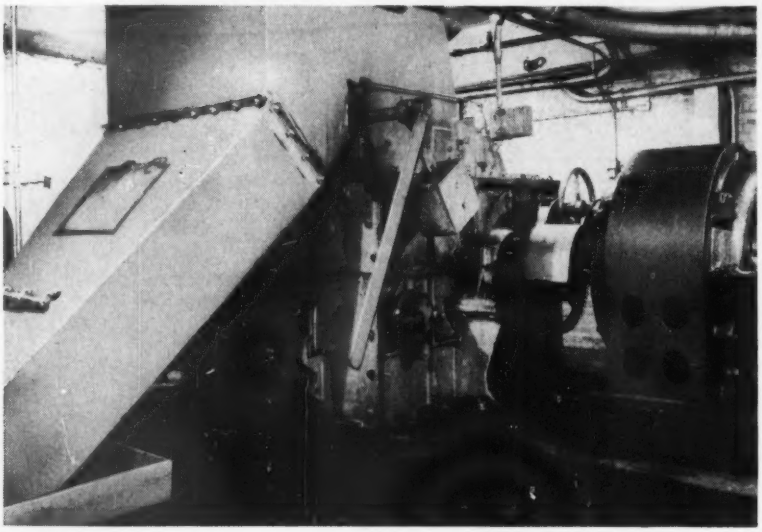
64 Genung Street, Middletown, New York

P.A. 1935

For more facts circle 272 on Reader Service card, p 99

CRUSHING FACTS

from *American* PULVERIZER CO.



USER REPORT

"7,000,000 TONS OF COAL reduced to 3/4" by this crusher, and it is still going strong"

After 23 years of operation, this American AC Rolling Ring Coal Crusher is still giving excellent service.

Replacement parts, plus standby parts, for reducing 7,000,000 tons of coal have cost less than 1/5 of a cent per ton. **Quality is proven only by performance.**

There are solid engineering reasons for this performance. The crushing elements, composed of American-originated rolling shredder rings, split coal instead of crushing it. This means less wear on screens and liners, less attrition in the crushing chamber. The rings are manganese steel and are reversible to give double wear. Liners are easily replaced.

The entire rotor assembly and bearings are so carefully machined, aligned and balanced that a nickel will stand on edge when the crusher is operating!

You can depend on performance like this when you use an American Coal Crusher. Our engineers will advise you on the correct model for your reduction problem.

American PULVERIZER COMPANY

ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

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For more facts circle 273 on Reader Service card, p 99

Compact 20-amp switch has modular design

30 • Rotary switch rated 600-v ac carries four isolated double-break silver-alloy contacts in each stage. You can use up to 48 contacts in minimum switch length of 12 stages. A double cam, arranged like a sandwich within the stage, operates contacts. You can set cams to operate or bypass preselected contacts so many arrangements are available.—American Solenoid Co, Inc

Just circle key numbers on the Reader Service card, page 99, to get complete product story

U-joints have 5000 to 180,000 lb-ft torques

75 • Needle-bearing joints are available as double-joint-shaft assemblies with or without slip, as short-coupled assemblies or as special assemblies with stub shaft. Joint disassembly is simple and fast, requires no special tools, maker says.

Built by Gelenkwellenbau of Germany, joints are made of case-hardened alloy or heat-treated steel. Double-lip seal fitted to ground journal surface of the cross prevents lubrication leakage and entrance of foreign material. Splines are designed for end movement, protect against joint breakage and wear.—Twin Disc Clutch Company

continued

(Advertisement)

How to Evaluate Cottrell Precipitators

How important is Precipitator Size?

A common fallacy assumes a larger precipitator with lower gas velocity is preferable to a smaller precipitator with higher gas velocity.

This assumption overlooks important economies now obtained with:

(a) Efficient voltage application

(b) Specific control of electrical sections

(c) Electrode design improvements

(d) Automatic Rapper Control

(e) Accurate internal baffling

(f) Proper control of gas flow, based on three-dimensional model studies

Close familiarity with these techniques and improvements has enabled us to guarantee 99% collection on large, modern installations.

Applied Voltage

Let's take Applied Voltage as a start. *If you double the operating voltage in a precipitator, it is equivalent to adding three times again as much collecting electrode area—or building a precipitator four times as big.*

If Applied Voltage is this important, how can evaluation engineers make sure a precipitator is operating with maximum voltage at all times?

Generally, the amount of arc-over in the precipitator determines the practical operating limit. Provision should be made in the precipitator's control to measure and integrate this arc-over so it can be used as the motivating factor in the control.

Stated simply, a precipitator must have control equipment which guarantees maximum voltage input regardless of changes in gas flow, particle size or resistivity, etc.

Sectionalization

Another important point in evaluating Applied Voltage is the question of how much sectionalization is provided in the specifications. Gas conditions are not constant throughout any precipitator. Higher efficiencies are obtained if the precipitator is divided into sections, each of which has its own voltage control set. In this way, maximum voltage is applied to each section regardless of variations in gas conditions from one section to another.

Reentrainment

Another factor affecting collection efficiency is the possibility of dust reentrainment. This refers to re-suspension of dust that has already been collected on the collecting electrodes.

Engineers are now demanding proof that collecting plate design provides correct baffling to shield the collecting surface against the sweeping and scouring effects of moving gas streams.

Precipitators using properly designed collecting electrodes can be 25% to 50% smaller than a precipitator using improperly designed electrodes. Once again, the emphasis is on proper design, not precipitator "size".

Proper Rapping

Another cause of reentrainment is improper rapping. A rapping blow that is too hard may dislodge too much collected dust and cause reentrainment. On the other hand, if the blow is too "soft", the dust builds up on the collecting electrodes, disrupts electrical conditions and necessitates reduced operating voltage.

As we said, conditions inside the precipitator are not constant. Gas flow, temperature particle size and resistivity are all constantly changing. Rapping intensity must also change to meet these varying conditions. This means that an evaluation engineer must be sure the rapping equipment specified is fully adjustable to meet all these changing conditions.

Sneakage

Now that collection efficiencies demanded by industry are becoming higher and higher, sneakage is an important consideration. This refers to that part of the gas stream which might sneak around the treatment zone.

Proper internal baffling is the only way to make sure that the entire gas stream flows through the treatment zone. For this, evaluation engineers must rely on the experience of the precipitator manufacturer in three dimensional model studies and research on full-scale precipitators.

Gas Flow Pattern

A major factor affecting the relationship between precipitator size and performance is the gas flow pattern across the face of the precipitator. When you consider the fact that proper flow can mean another 25% - 50% reduction in precipitator size, it pays to investigate the design elements affecting this gas flow pattern. Again, evaluation engineers should ask the manufacturer how he has provided for correct gas flow.

In this brief review we have been able to hit only a few high spots of precipitator evaluation. It is a complicated problem because of the many variables in gas conditions and the combinations of electrical, electronic and mechanical equipment involved.

If you want more information on any of the points discussed in this review, please contact your nearest Research-Cottrell representative or write us in Bound Brook, N. J. Our 48 years of gas cleaning experience are at your service.

Research-Cottrell, Inc.
Office and Plant: Bound Brook, N. J.
Representatives in principal cities of U.S. and Canada

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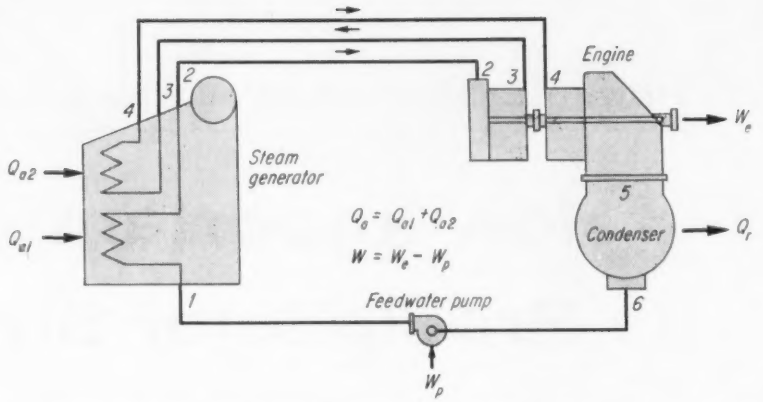


1 Reheat cycle takes steam partly expanded in first section of engine back to the steam generator to be reheated. Then steam enters second section to do more work

Building on basic ideas can show ways to better machinery performance. The Rankine steam power cycle can be improved by a variety of tricks to get better thermal efficiency; here we learn how . . .

Reheating can improve cycle efficiency

By B G A SKROTZKI, Associate Editor

Engineering strives to make all its materials work to best advantage. In power generation this means trying to convert most of all heat inputs to mechanical-work output. In the last two parts we studied the Rankine cycle, Fig. 2, and found what we could expect in the way of performance. But as we pointed out, this is a basic cycle and could stand much improvement.

One way we can improve the cycle is by finding a way to raise the average temperature of heat addition Q_a. Fig. 1 shows one means of doing this. Full-pressure throttle steam enters the engine as in the Rankine cycle, but the steam is only partly expanded, *2-3*. Steam at the lower pressure then flows back to the steam generator through a superheater to be reheated, usually back to its throttle temperature, *3-4*. At *4*, reheated steam enters the second or low-pressure section of the engine and expands to backpressure held by the condenser at *5*.

Cycle input consists of two parts, Q_{a1} and Q_{a2}. In most engines and turbines the output of the cycle will be through one shaft as W_e. In all other respects, reheat cycle is the same as the basic Rankine cycle.

Pressure at which the steam is reheated can be varied. Fig. 3 shows the steam expanded through a relatively small pressure drop *2-3*. In the ideal cycle, steam is reheated at constant pressure from *3* to *4*. It then expands at constant *S* to state *5* in the condenser.

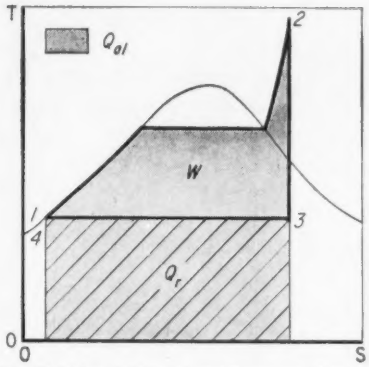
The gray area under *1-2* measures heat input to the boiler and main superheater, Q_{a1}. The darker area under *3-4* measures heat input to the l-p reheat steam, Q_{a2}. Reheater is usually a second superheater, taking its heat from the furnace gases of the boiler that also supply Q_{a1}.

By varying the pressure of state *3* we can control the average temperature at which Q_{a2} is added to the cycle. For instance, in Fig. 4 state *3* is at a lower pressure and Q_{a2} is larger than in Fig. 3, but average temperature of addition is lower because of the wider temperature range during the addition.

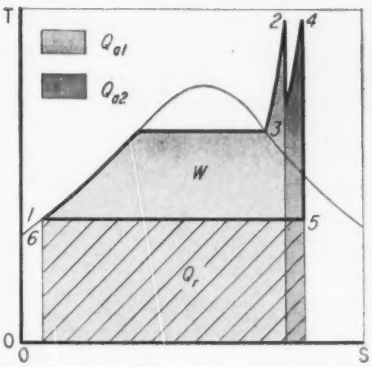
To get best reheating pressure we have to find the balance where the additional heat and its average temperature become optimum.

In Fig. 3 and 4 for the ideal reheat cycle, net area enclosed by heavy process lines measures net mechanical-work output W. As usual the crosshatched area shows entire unavailable heat Q_r rejected from the cycle. Area to the left of *6-1* paralleling the saturated-liquid line measures the pump work input W_p; this area becomes significant only at high pressure ranges for the cycle.

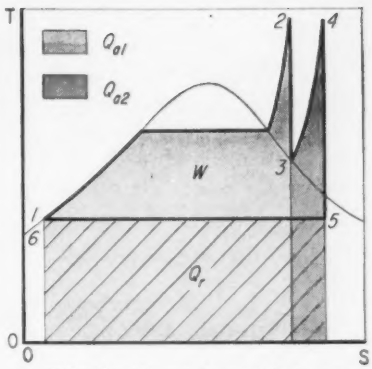
Cycle thermal efficiency is figured as the ratio of output to input as for other cycles. Referring to Fig. 1, 3 and 4 we get:



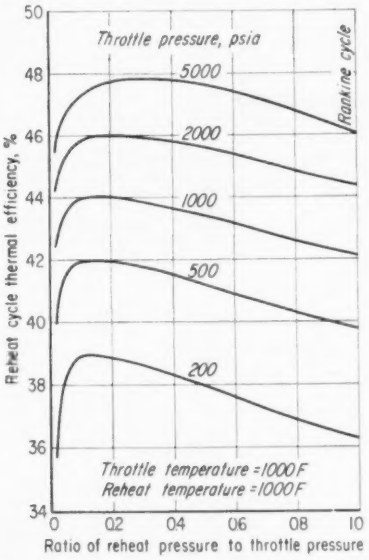
2 Rankine cycle uses minimum number of steam processes to produce work output



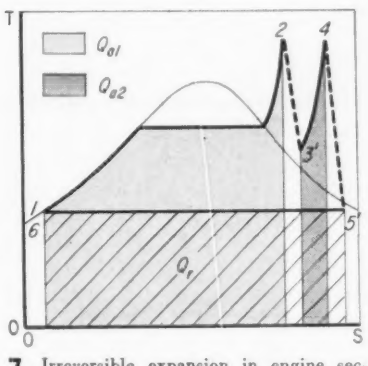
3 Reheat cycle has partly expanded steam reheated in steam generator from *3* to *4*



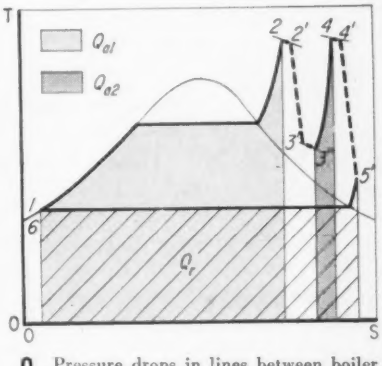
4 Reheat cycle can be varied in amount of expansion used in engine parts



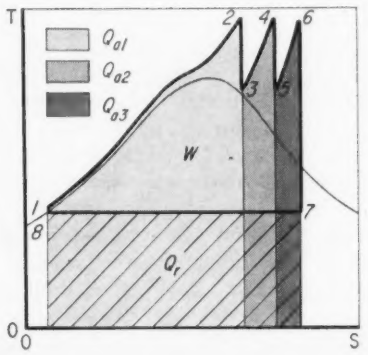
5 Thermal-efficiency improvement by reheating depends on reheat pressure



7 Irreversible expansion in engine sections reduces reheat-cycle performance



8 Pressure drops in lines between boiler and engine reduce the cycle efficiency



6 Multiple reheat stages raise theoretical cycle efficiency to higher levels

$$e = \frac{W}{Q_a} = \frac{W_e - W_p}{Q_{a1} + Q_{a2}}$$
$$= \frac{(H_2 - H_3) + (H_4 - H_5) - W_p}{(H_2 - H_1) + (H_4 - H_3)} \quad (1)$$

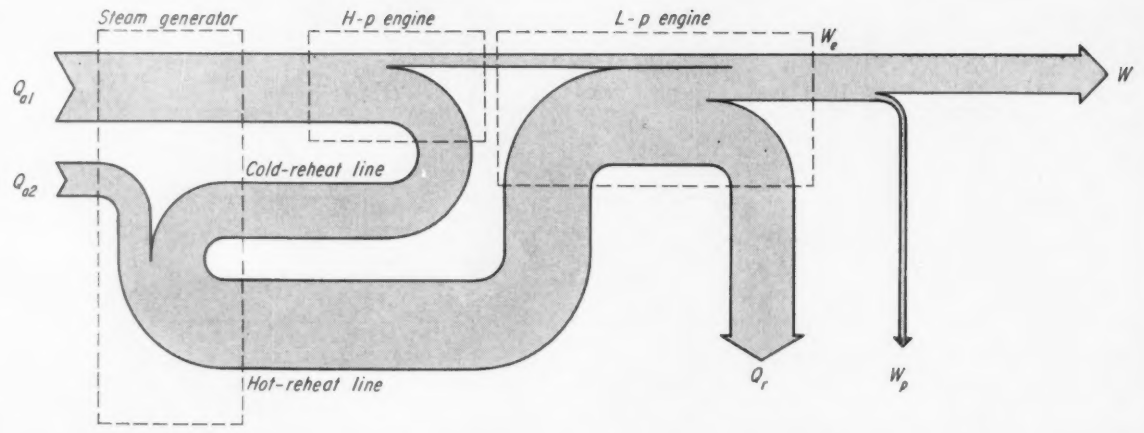
where the H's correspond to states given in the figures.

Reheat pressure influences overall thermal efficiency of the cycle as we've just discussed. Fig. 5 shows how thermal efficiency varies with reheat pressure for five different throttle pressures. In all curves both throttle and reheat temperature are constant at 1000 F, exhaust at 1-in.-Hg abs. At unity pressure ratio of reheat to throttle pressure we have the same cycle as the Rankine; that is, reheating is actually zero.

As we lower reheat pressure (and H_3), overall cycle thermal efficiency steadily rises until it reaches a maximum at pressure ratios varying from about 0.12 to 0.3 depending on the throttle-pressure level. Further pressure reduction drops cycle efficiency sharply towards zero.

Theoretically, reheating has more to offer at the lower throttle pressures than at the higher, but significant gains can be made at all levels. In practice, in more-complicated cycles we'll discuss in later parts, reheating is more often used at the higher pressures.

Multiple reheating. A few power-plant cycles running at superpressures are using two stages of reheating because of the gain in overall cycle thermal efficiency. Fig. 6 shows a theoretical superpressure cycle with two stages of reheating. Three separate inputs, Q_{a1}, Q_{a2} and Q_{a3}, power the cycle. Adding "saw-tooth" edges to the top of the diagram adds additional heat at a high average tempera-



9 Energy-flow diagram for reheat cycle shows Q_{a1} as largest part of total input. Cold reheat line carries major share of energy leaving h-p engine. When engine sections have common shaft, l-p engine output augments h-p engine output to make W_e

How to figure single-stage reheat-cycle performance

Find thermal efficiency of reheat cycle with:
Throttle pressure = 2000 psia
Reheat pressure = 400 psia
Throttle and reheat temperatures = 1000 F
Condenser pressure = 1-in.-Hg abs
Engine efficiencies of h-p and l-p engines = 80%

Using symbols of Fig. 7, previous page:
$P_2 = 2000$ psia $T_2 = 1000$ F $S_2 = 1.5603$
$H_2 = 1474.5$ Btu per lb (from steam tables)

Enthalpy at 400 psia after constant-S expansion from H_2, read from Mollier chart = 1276.8 Btu per lb = H_3
$H_2 - H_3 = 1474.5 - 1276.8 = 197.7$ Btu per lb
$H_2 - H_{3'} = 197.7 \times 0.8 = 158.2$ Btu per lb = W_{e1}
$H_{3'} = H_2 - W_{e1} = 1474.5 - 158.2 = 1316.3$ Btu per lb
$P_4 = 400$ psia $T_4 = 1000$ F $S_4 = 1.7623$
$H_4 = 1522.4$ Btu per lb (from steam tables)

Enthalpy at 1-in.-Hg abs after constant-S expansion from H_4, read from Mollier chart = 947.4 Btu per lb
$H_4 - H_5 = 1522.4 - 947.4 = 575.0$ Btu per lb
$H_4 - H_{5'} = 575.0 \times 0.8 = 460.0$ Btu per lb = W_{e2}
$H_{5'} = H_4 - W_{e2} = 1522.4 - 460.0 = 1062.4$ Btu per lb
$H_6 = 47.1$ Btu per lb at 1-in.-Hg abs
$W_p = 5.5$ Btu per lb (from compressed-liquid table)
$H_1 = H_6 + W_p = 47.1 + 5.5 = 52.6$ Btu per lb

$$e = \frac{(H_2 - H_{3'}) + (H_4 - H_{5'}) - W_p}{(H_2 - H_1) + (H_4 - H_{3'})}$$
$$= \frac{(1474.5 - 1316.3) + (1522.4 - 1062.4) - 5.5}{(1474.5 - 52.6) + (1522.4 - 1316.3)}$$
$$= \frac{158.2 + 460.0 - 5.5}{1421.9 + 206.1} = \frac{612.7}{1628.0} = 0.3766$$

or cycle thermal efficiency of 37.66%

---

ture which raises the cycle efficiency.

Point of diminishing returns may be reached quickly with added reheat stages because of the complication of equipment. Added reheaters must be installed in the steam generator, engine needs additional sectionalization and more piping must be installed to hook up the more-complex cycle. Even the thermal-efficiency formula becomes more complicated:

$$e = \frac{(H_2 - H_3) + (H_4 - H_5) + (H_6 - H_7) - W_p}{(H_2 - H_1) + (H_4 - H_3) + (H_6 - H_5)}$$

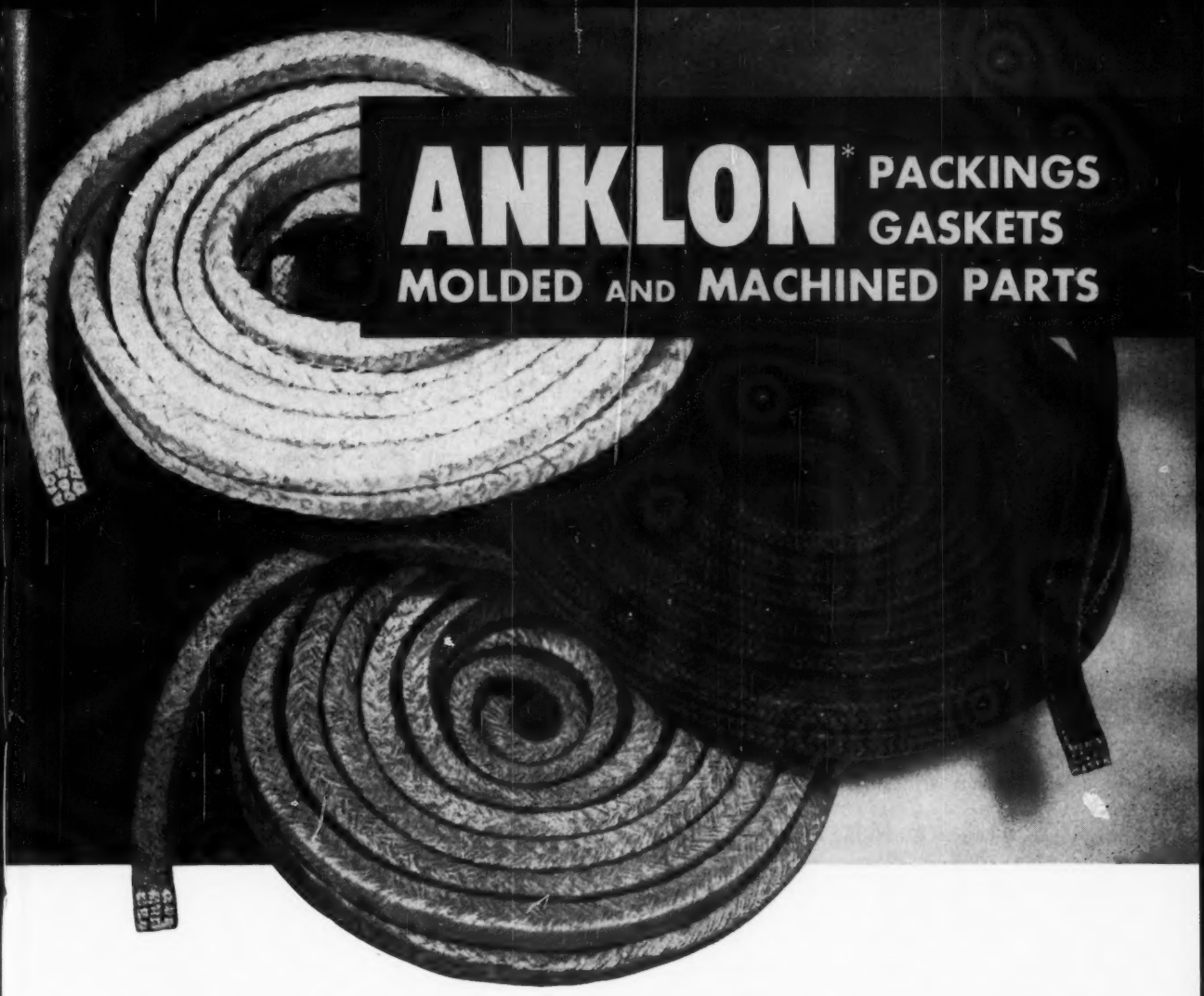
Irreversibilities, as in all cycles, decrease thermal efficiency of the reheat cycle. Prime loss results from the irreversibility of steam expansion in the engine. Fig. 7 shows its effects. Expansion through the h-p section of the engine is from *2* to *3'* at increasing *S*. We assume reheating takes place reversibly from *3'* to *4*. Then steam expands irreversibly from *4* to *5'* in the l-p section of the engine.

Total energy rejected Q_r is then the total hatched area under *5-6*. Net work is not described by a single area but is the difference between sum of areas under *1-2* and *3'-4* less Q_r. This will be considerably less than the two gray areas above *5'-6*.

Considerable pressure drop has to be built into reheaters to insure steam filling all the parallel tubes and preventing the metal from overheating. Pressure drop through connecting piping is unavoidable; the practical reheat cycle has these irreversibilities in addition to those of engine expansion. Fig. 8 shows these effects. Net result increases Q_r at the expense of decreasing W.

Next month we study the regenerative cycle.

circle 275 on Reader Service card, p 99 ➤



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How American Industry Points The Way To Sustained Prosperity in 1961

Something new and very constructive is happening in American industry. It promises to add a major element of strength to business not only in 1961 but right along over the years ahead.

What is happening is essentially this. **American industry is planning to continue to invest heavily in new and better producing facilities in spite of the fact that it has an excess of capacity to produce its present range of products. And, by doing so, business is helping to shape a stronger American economy.** For the continuation of a high level of capital investment by business is one of the most important keys to sustained prosperity.

News of this major new development in American industry is provided by the results of the McGraw-Hill Fall Survey of Business Investment Plans for 1961 and 1962, presented in detail at the right. The McGraw-Hill investment surveys, now in their 13th year, cover a broad cross-section of American industry.

How American industry is aiming to go ahead with a big investment program in spite of its present burden of excess producing capacity is highlighted by the plans of manufacturing companies. The McGraw-Hill fall survey finds that, on the average, these companies are using slightly less than 80 per cent of their producing capacity. They would like to be using well over 90 per cent.

Dramatic New Departure

If historic investment patterns were being followed, our manufacturing companies, with only about 80 per cent of their capacity being employed, would be cutting back new investment programs drastically, and cutting down prosperity in the process. **But — and here is the dramatic new fact — they plan almost no cut-backs in their investment programs.** They plan to invest almost as much (within 3%) in 1961 as they are investing this year. And this year they are investing 19 per cent more than they did in 1959.

There are two major reasons why American industry is unwilling to let its excess producing capacity stall its investment in new facilities until the capacity is more fully used. One is that a lot of this capacity is obsolete and costly to operate. Increasingly rugged competition is creating a strong inducement to replace this antique capacity with modern, more efficient equipment which is widely available.

PLANS FOR CAPITAL SPENDING
(Billions of Dollars)

INDUSTRY	1959 Actual*	1960 Estimated*	1961 Planned	1960-1961 % Change	1962 Planned
Iron and Steel	$1.04	$1.52	$1.37	—10%	$1.18
Nonferrous Metals	.31	.34	.34	0	.32
Machinery	.91	1.15	1.11	— 3	1.11
Electrical Machinery	.52	.62	.68	+10	.63
Autos, Trucks & Parts	.64	.89	.95	+ 7	1.02
Transportation Equipment (Aircraft, Ships, R.R. Eq'pt.)	.39	.41	.37	—10	.35
Other Metalworking	.88	.97	.85	—12	.87
Chemicals	1.24	1.61	1.64	+ 2	1.59
Paper and Pulp	.63	.75	.69	— 8	.53
Rubber	.19	.24	.23	— 4	.20
Stone, Clay and Glass	.53	.63	.56	—11	.55
Petroleum & Coal Products	2.49	2.45	2.52	+ 3	2.50
Food and Beverages	.82	.94	.99	+ 5	.97
Textiles	.41	.53	.42	—21	.40
Miscellaneous Manufacturing	1.07	1.28	1.21	— 5	1.13
ALL MANUFACTURING	12.07	14.33	13.93	— 3	13.35
Mining	.99	.99	.90	— 9	.89
Railroads	.92	1.04	.79	—24	.83
Other Transportation & Communications	4.69	5.20	4.61	—11	4.18
Electric And Gas Utilities	5.67	5.89	6.14	+ 4	6.01
Commercial (1)	8.21	8.61	8.70	+ 1	8.54
ALL BUSINESS	32.55	36.06	35.07	— 3	33.80

*U.S. Department of Commerce, Securities and Exchange Commission, McGraw-Hill Department of Economics.

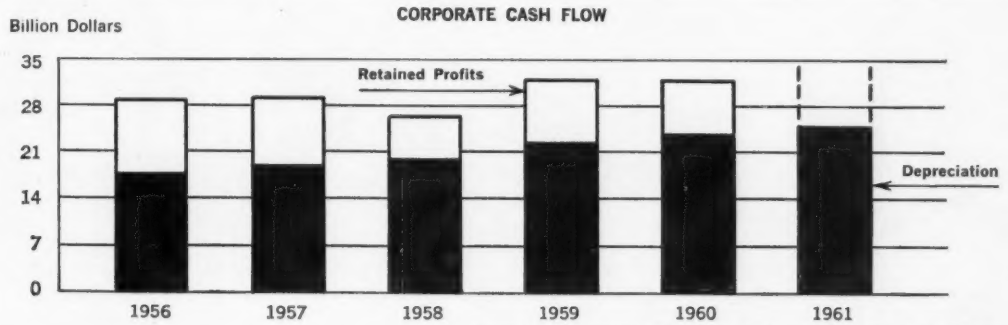
(1) Figure based on large chain, mail order and department stores, insurance companies, banks and other commercial businesses.

"R And D" Paves The Way

The steel industry provides a good case in point. Despite an operating rate of little more than 50 per cent during the last six months, steel companies plan a total investment of nearly $1.4 billion in 1961. And though this is 10 per cent below their capital expenditures in 1960, it will still be the third highest year on record.

incentive and wherewithal to continue a vigorous program of new investment. In addition, if price inflation were to begin surging again, it would eat away the power of depreciation reserves to purchase new plant and equipment.

The allowances now permitted American industrial firms for the depreciation of their producing facilities are lower than those made in any of the industrial countries with which we are in increasingly tough competition. More adequate allowances would speed up the job of modernizing American industry. An earlier McGraw-Hill survey indicated that it would cost only slightly less than $100 billion to bring our nation's plant and equipment up to date.



Source: U.S. Department of Commerce; McGraw-Hill Department of Economics

Also, new investment is required to tool up for the manufacture of the new products being spawned by the continuing boom in industrial research and development. This year, we are spending about $13 billion (that's *billion*) for all research and development, about $9.6 billion of it through industry.* And out of it is coming the "know-how" for a veritable flood of new products, processes and equipment, most all of these calling for new producing equipment. Next year, American manufacturers plan to get 12 per cent of their sales in products that did not even exist four years ago.

Key Role Of Depreciation Reserves

A major reason why American industry can combine the desire to carry out big new investment programs with the necessary financial capacity to do it is to be found in the growth of its reserves for depreciation. This year, (1960), business has been in a squeeze between costs and the prices it could get for its products. This cost-price squeeze has reduced profits sharply. The total of profits for the year will be down about 5 per cent.

Allowances for the depreciation of existing plant and equipment, however, have continued to rise. The result is that the so-called cash flow of corporations (their retained profits plus their allowances for depreciation) is the same this year as last. And this cash flow, shown in the chart above, makes a decisive contribution to financing new investment.

Inflation Would Be Deadly

If the sort of profit squeeze that has prevailed this year were to become chronic, it would blight both the

But at this juncture, American industry's eagerness and capacity to maintain a high level of investment capital is adding a great new element of constructive strength to the nation's economy.

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*The significance of this boom for American industry is analyzed in a new McGraw-Hill book, "The Research Revolution" by Leonard Silk, Economics Editor of BUSINESS WEEK. Together with other new business investment trends the "R & D" boom also constitutes a key part of another new McGraw-Hill book, "New Forces in American Business" by Dexter M. Keezer and associates — the November selection of the Business Book Club.

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Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY

"Merry Crissmus, fellas," hiccupped Grogan, happy as a lark. "I been cel'bratin' a liddle an' dropped in to wish ya workin' stiffs a Merry Crissmus."

Marmy's bowed shaft

"He dented me noggin wid a spittoon, Sarge," moaned Burly Grogan to the case-hardened sergeant at the 2nd Precinct police station on San Francisco's Embarcadero. "An' after me doin' him a big favor at da power station las' July." Red faced, bleary eyed, Grogan looked disheveled even though he was wearing a light trench coat over a neat pin-striped suit. His head was swathed in white bandages, giving him the appearance of a Far Eastern potentate.

The large wall calendar in back of the sergeant carried a plug for Sandpaper Gin served at the Golden Gate Bar, "the sailors' haven for good spirits." It was Christmas Day, December 25, 1951.

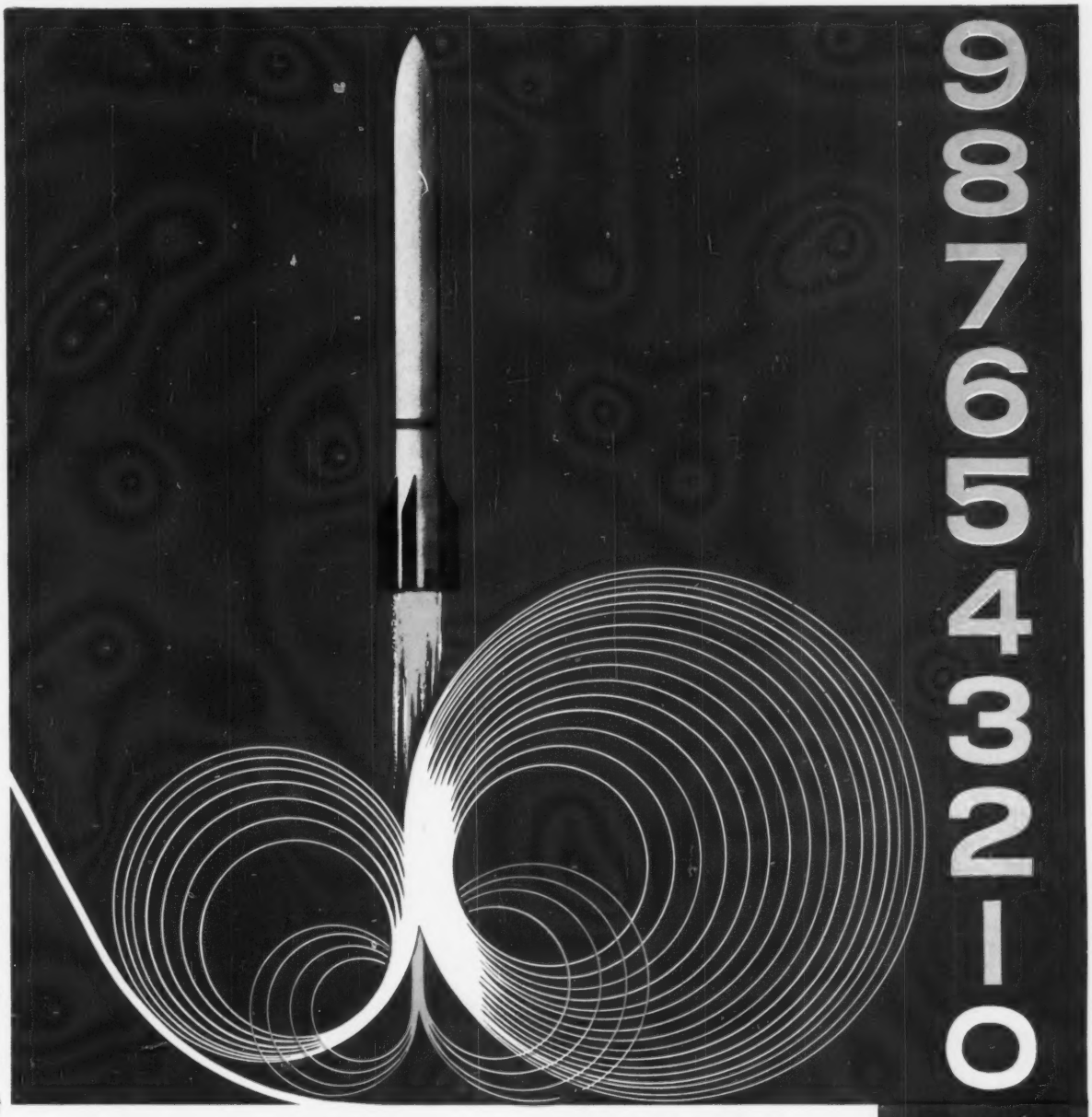
"Calm down, Burly, me lad, and answer me questions," admonished the sergeant, adjusting his glasses as he wrote down the complainant's name and address. "What's the rough-neck's name who slugged you this time?" he asked, contorting his face into a wry smile.

"Marmaduke Surfaceblow," piped up Grogan belligerantly, as he tenderly rubbed his bandaged head with his left hand. Then he added, "ya know that overgrown baboon, Sarge. He's maint'nance foreman at da power plant where I been slavin' to make his life easier. . . ."

While this unhappy scene unfolded at the police station, another storm was brewing in the superintendent's office at the power plant a few blocks away.

"Look here, Marmy," said Fred Dixon, the good-natured super, looking the two-fisted giant before him calmly in the eyes. "It's bad enough to have No. 2's feed pump conk out on us for the second time in six months, but parting Grogan's hair with a cuspidore isn't exactly nice . . . and on Christmas morning, at that. Where's your spirit of good will?" As the super puffed on his curved-stem pipe, he continued, "besides, he's a good mechanic even if he does go berserk and try to knock someone galley-west every time he takes on a full cargo of liquid ballast."

"BILGEWATER on Grogan's jury-rigged schemes," roared Marmaduke Surfaceblow in his foghorn voice, pounding his huge hairy fist onto the super's table until that unhappy gent's reading spectacles vibrated on his nose. "I ordered that chowder-headed harp player to scrap that bent feed-pump shaft before I went on my vacation last July. But what does he do?—pulls a fast one



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For more facts circle 277 on Reader Service card, p 99

Marmaduke

Begins on page 132

and straightens it instead. So she conks out and here we are on Christmas Day playing nursemaid to a sick pump instead of playing Santa Claus."

The gentleman blasting away was a tall, muscular character, wearing a dented gray bowler atop his unruly hair. He paced angrily back and forth in front of the super's desk each time he sounded off. With fists hooked into his suspenders, he was puffing furiously on a piece of rope yarn and blowing clouds of acrid blue smoke through his nostrils at each turn of his angry pacing.

But let's get back to the feed pump in question. She was only two years old, of barrel design, with six stages and rated at half a million lb of water per hr at 3550 rpm. She fed a 1200-psi boiler by building up a discharge pressure of 1450 psi. Water entered her suction side at 278 F.

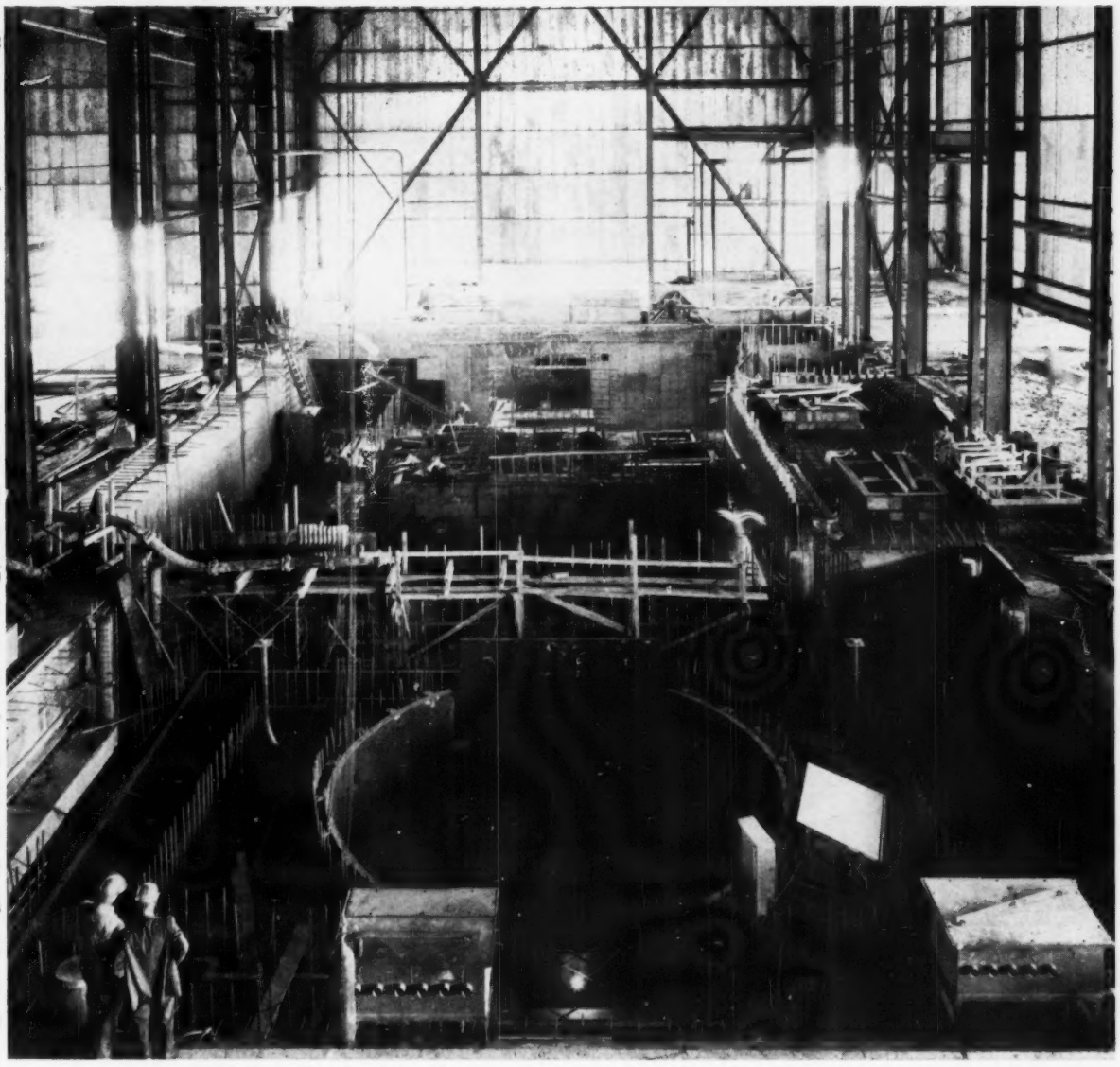
Trouble first started six months before the ridiculously unfortunate incident at the police station. At that time the pump had begun to vibrate slightly. Shift foreman immediately put the standby on the line, then stopped the vibrating pump. After opening her up and removing the impeller, Marmaduke found the 4-in.-dia shaft was bowed about 10-thousandths of an inch. There were indications that the impellers nearest the shaft's center were rubbing slightly on the wearing rings of the pump.

Marmaduke Surfaceblow had taken one look at the bent shaft, told Grogan to replace it with a spare. Then he shoved off for a long-overdue vacation into the Sierra mountains of California.

But Grogan had his own idea. Instead of replacing the bowed shaft, he placed it between the centers of the big engine-lathe. Then he heated the bowed part near the center with two large ring burners until the shaft glowed a cherry red. Prying up against the bowed part with a long heavy bar, testing for straightness, heating and prying again and again for most of that day, he finally had it straightened.

Next morning he brought the entire shaft up to a cherry red, then

75,000 KW Sodium Graphite Reactor station for Consumers Public Power District at Hallam, Nebraska



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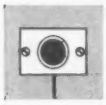
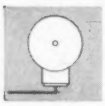
Here's what they do!

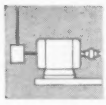
What you see here is a compact, well-built switch that makes or breaks a circuit (as required) when liquid flows or stops flowing. It's an economical and positive way to start or stop anything electrically operated. Just to highlight a few uses:



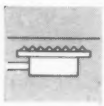
to actuate a signal light—signal an attendant to make the right moves in operating valves, pumps and the like—signal him when flow stops in a water cooled compressor, water cooled bearing and so on.



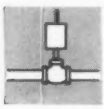
to sound an alarm—when flow stops in a process system or in any water cooled devices.



to start or stop motors—start pumps in sequence in multiple stage flow systems; start standby pumps; stop automatically controlled units if cooling water system fails; stop compressors in cooling systems when flow stops.

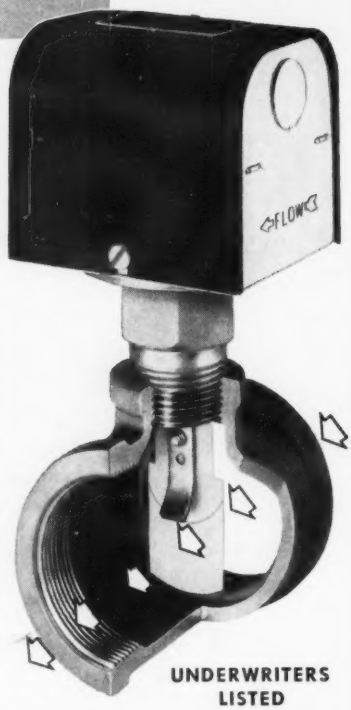


to start or stop automatic burners—start a booster heater when water draw occurs, stop burner if flow is improperly retarded; make sure of circulation in a boiler before burner is permitted to start.



to actuate metering device—open valve in chemical feeder line; start mixing in secondary line whenever flow starts in primary line.

FS4 Series Flow Switch shown mounted in a 2 inch Tee



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FS4—Closes with flow; opens with no flow.

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For more facts circle 279 on Reader Service card, p 99

Marmaduke

Begins on page 132

annealed it by letting it cool for 24 hr. After that treatment, the shaft when placed between lathe centers showed less than a 1-thousandth runout against the dial indicator. So Grogan assembled the impellers onto the shaft, assembled the pump. That evening, between drinks at the Golden Gate Bar, he did a little bragging about saving the old shaft. But he was smart enough not to mention it to Marmaduke when that two-fisted gentleman returned from vacation.

Four months later the pump had again started to vibrate, but this time it was ever so slightly. With No. 5 unit and its pump torn down for annual inspection, No. 2 pump was the only standby and badly needed. So the super decided to keep her running until the other equipment was buttoned up. The vibration got gradually worse, but so slightly that its worsening was hardly noticeable.

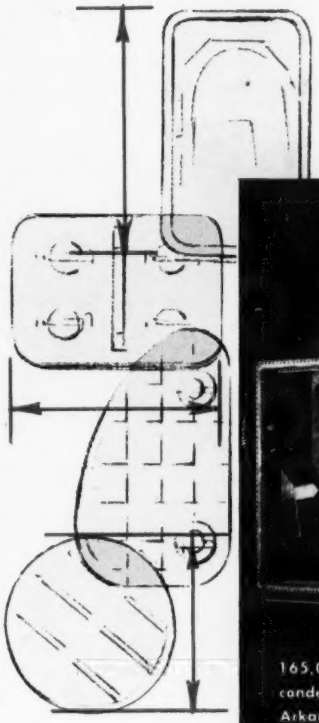
Close to midnight on Christmas Eve, No. 2 started to act up, then suddenly gave an agonized squeal as her impellers rubbed the wearing rings. The shift engineer divided the load between the other three units and hurriedly shut down No. 2.

When the super was notified at his home, he placed a call to Marmaduke at his boarding house near Fisherman's Wharf. But a sleepy feminine voice informed him that the star boarder wasn't there, perhaps could be found at the Golden Gate Bar. After more phoning, Marmy finally showed up at the plant with fire in his eyes and mayhem in his heart.

After looking the situation over, Marmy quickly rounded up a few night maintenance men and started pulling the pump's guts. One look at the impellers and wearing rings told the story. The shaft was bowed, no doubt about it.

"What I can't understand," rasped Marmy as he examined the shaft carefully, "is why two shafts should bow in this pump. And now we're really on the rocks because we used up the spare."

"This isn't the new shaft, Marmy," corrected Gunar Bjurkland, one of the mechanics. "This is the old shaft that Grogan straightened. And I gotta admit that guy's good—he had



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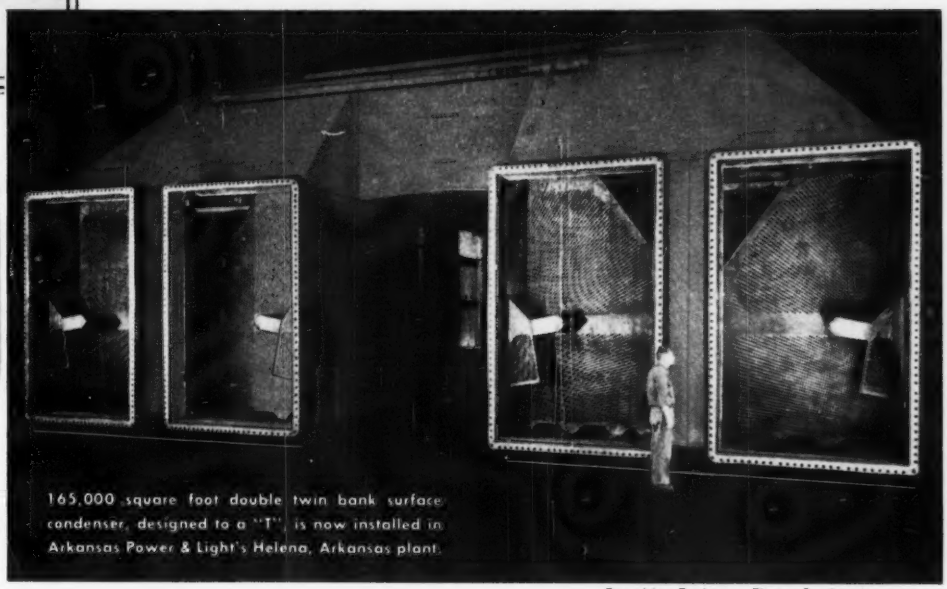

165,000 square foot double twin bank surface condenser, designed to a "T", is now installed in Arkansas Power & Light's Helena, Arkansas plant.

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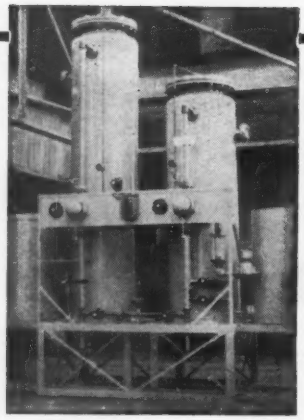

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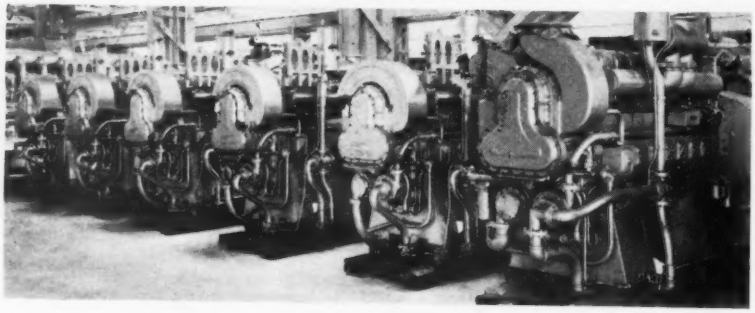

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Marmaduke

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her straight enough to please a bishop."

"What?" echoed Marmy in his klaxon voice, "he didn't replace that crooked shaft like I damn well told him to . . . and we still got the spare?" Then his leathery face turned lobster red as his mind got the full impact of that information. For a second he froze in his tracks, his fists clenched tightly into battering rams.

"OK," he finally groaned, as if slowly relieving tons of pressure. "Bring that spare and let's put her in and get this pile of scrap iron closed up. It's been a long day since 2 am and I've got some serious business to finish at the Golden Gate."

But just as Marmy spoke, who should come staggering into the hot pump room but Grogan himself. He was wobbling like a ship's mast in a heavy ground swell and his bulbous nose glowed a Christmas red above his handlebar mustache.

"Merry Crissmus, fellas," he hiccupped, happy as a lark. "I been cel'bratin' a liddle in da neighborhood and tought I'd drop in an' wish ya workin' stiffs a Merry Crissmus." He evidently was too embalmed to wonder why Marmy and his gang were working on Christmas Day.

No one said a word, but Marmy walked up to him slowly. His eyes were bloodshot from lack of sleep and like his mechanics, he was dirty and soaked in sweat.

"I understand you didn't scrap this pump's shaft last July like I told you?" rumbled Marmy, giving him a menacing look.

"Tha's right," answered Grogan, doubling his left fist and socking Marmy on the shoulder for emphasis. "I can straighten any bowed steel ya got—see?" Then he stuck his face up to Marmy's and sneered, "an I can straighten ya out too if yer lookin' for trouble." With that Grogan unexpectedly grabbed the big monkey wrench near him on the pump's pedestal bearing. But that's as far as he got.

Marmy dropped as if descending into an open manhole, grabbed the brass cuspidore near his heels and

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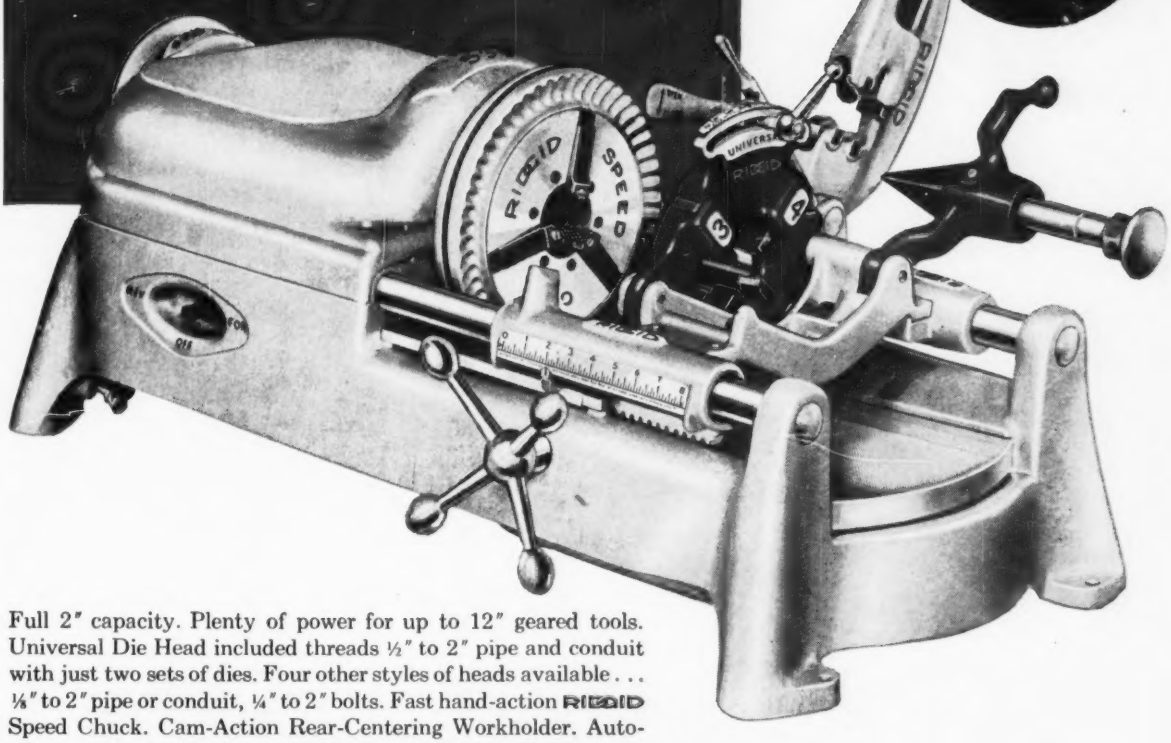

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Marmaduke

Begins on page 132

with one even sweep of his right arm bounced it gently but firmly against Grogan's muddled noggin. . . .

When Grogan came to he navigated a somewhat circuitous course to the super's office on the deck above. Ten minutes later Fred Dixon sent for Marmy.

"Just tell me why you hauled off at Grogan for straightening that bowed shaft," asked Dixon, puffing on his pipe. "Getting a bow out of a 4-in. shaft is a pretty neat trick," he continued. "Seems to me he did a good job even if he went against your orders."

"BILGEWATER on straightening shafts," roared Marmaduke, pounding on the super's table. "There's no such thing as a straight high-speed shaft once it has bowed. Even if it's straightened to run dead true and annealed to relieve the stresses set up by bending and heating, it'll still bow gradually until it tags home plate where it started from. And that's exactly what that shaft did. Only this time it almost wrecked the pump and got us turned-to on Christmas Day."

Dixon straightened his dancing specks and studied his irate maintenance foreman calmly. "That's a new one on me," he finally answered when Marmy stopped exploding. "Why should it return to its original bow if properly annealed?"

"Don't ask me," barked Marmy, lighting a new cigar he grabbed from the super's desk. "Even the metallurgists don't agree on the answer. So I don't claim to know. But I do know there's only one right thing to do with a bowed rotary shaft of any high-speed machine—*give it the deep six.*"—SME

Marmy's mailbox

BRINGS MEMORIES

Marmy mentions the old stern-wheeler river towboats *Sprague* and *Alliquippi* in a story. That brings back many boyhood memories. There were towboats with those names on

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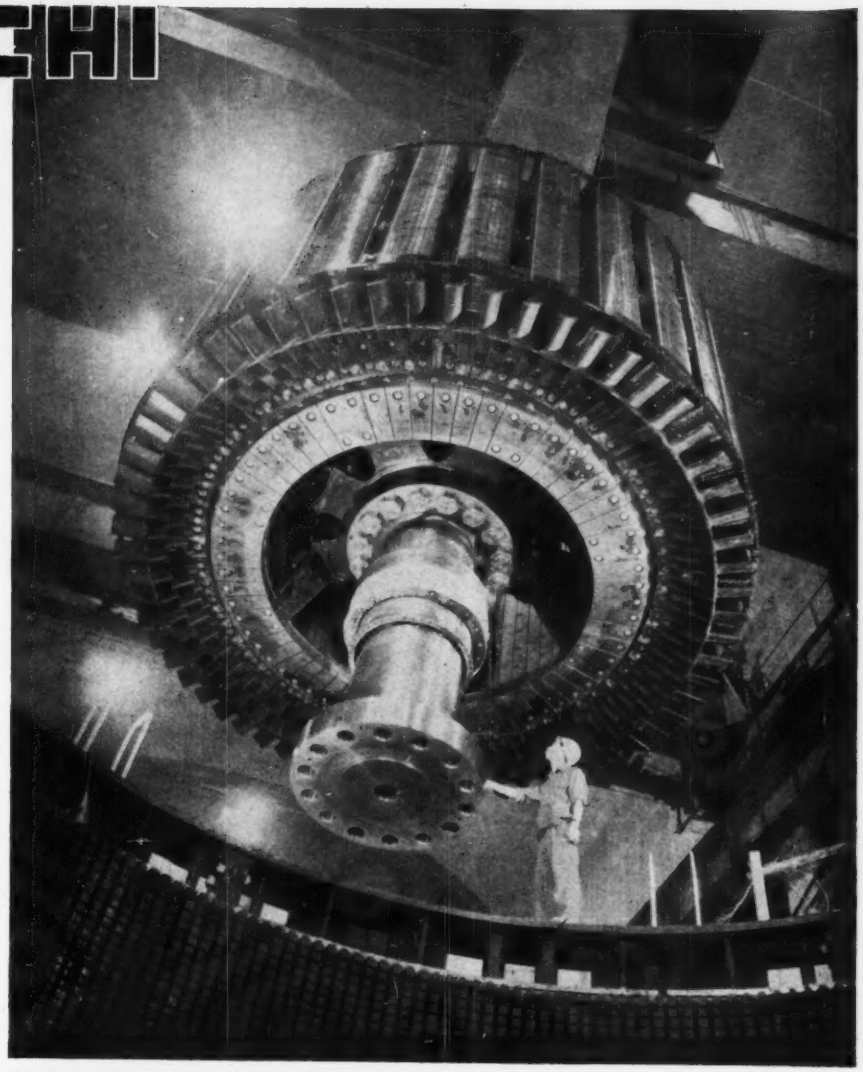

Hitachi has recently completed two 137,500kw/125,000kVA hydraulic turbines and generators for the Miboro Power Station in Central Japan. The turbine is of the vertical-shaft Francis type, and specified for a speed of 225rpm, a maximum effective head of 200m and 76.6 cu.m/sec. water flow, making it one of the largest units of its kind in the world. Its runner has a maximum diameter of 3.7m and the main shaft a diameter of 95cm. The spiral casing, which was constructed in 13 sections to facilitate transportation to the site, has an inlet diameter of 3.35m and an outer diameter of 11.2m.

The generator presents a high-torsoed appearance having been so designed in consideration of the comparatively high speed. Since the generator was designed for a rated voltage of 16,500 volts and, in this respect, represents the first such attempt in Japan, particular care was taken in the corona-shielding and impulse resistance of the stator winding. The generator is rated at 60 cycles, 225rpm and 0.9 power factor but is also capable of operating at 50 cycles, 187.5rpm and 1.0 power factor.

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For more facts circle 286 on Reader Service card, p 99

Begins on page 132

the Ohio River. As a boy 30 years ago I would swim out behind them off the Bellevue shore and ride the wheelers—waves left by the paddle wheels. Thanks to Marmy for bringing back a few moments of my youth.

M H CHARTERS,
Edgewater Works, N. J.

OLD FRIEND

I have enjoyed the Marmaduke stories for years. My background includes marine engineer, utility operator, insurance inspector, boiler-service engineer, so you can appreciate my interest in Marmy's colorful experiences.

H MOORE, *Trumansburg, N. Y.*

CAN MARMY HELP?

While reading Marmaduke this month it dawned on me that anyone associated with him should know about license examinations in the various states. Can you send me the requirements for Michigan?

K J MONTANYE,
Barranquilla, Colombia

EDITOR'S NOTE: *Yes*—POWER *made a survey of license requirements for operating engineers in the U.S. and Canada. This information now takes up 54 pages in Chapter 20 of* Standard Plant Operator's Questions and Answers, *published by McGraw-Hill Book Company, N. Y. This is the only survey of its kind ever made.*

LIKES NEW STYLE

Condolences to exproofreader M E Sussman. She/he overlooked a superfluous apostrophe in your November yarn, *Marmy's hat trick,*—the charm of your narrative. And it was good, too. One of your very best. You have a new style. It is smooth, has better flow and a more sophisticated vocabulary. What's up? Have you shifted some of the Sandpaper-Gin time to studying Sevpost style? Have you been taking a writing course at night school or (ugly thought) working harder? If not any of these, who's the ghost writer? Anyway, continued success.

B TENANCE, *Milwaukee, Wis.*

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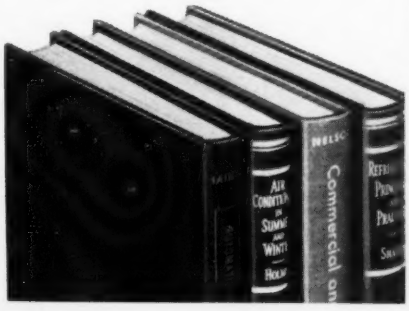

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P-1

For more facts circle 287 on Reader Service card, p 99

Powerscope . . . A selective look at

Gas-turbine growth

South Carolina Electric and Gas Company has bought four of the new packaged 11-mw gas-turbine units built by General Electric Company. These factory-assembled units are designed for peak load, emergency and standby service. The first two units are scheduled to start at Beaufort, S.C. in June 1961 and the second two in Charleston, S.C. in mid-'63. These units cost $100 per kw installed on sites provided by the purchaser. They can be remotely controlled. A 10x36-ft power unit holds gas turbine, station controls and mechanical and electrical auxiliaries. The 10x28-ft unit holds the generator, reduction gear, exciter and cooling-air system. Air-inlet ducts, exhaust stack, maintenance crane and outdoor metalclad switchgear make up the plant accessories. Units can carry load ten days after delivery to the site. They can carry full load within 15 minutes from cold shutdown.

A 10,500-hp Cooper-Bessemer jet gas turbine driving a 2-stage centrifugal gas compressor started operation in October 1960 in the Columbia Gulf Transmission Company's main line station at Clementsville, Ky. This experimental unit cost $190 per hp compared to $365 per hp for a conventional reciprocating-engine plant—a traditional industrial gas-turbine plant costs somewhat less than $365. New unit's gas generator is a modified Pratt & Whitney jet-aircraft engine. Cooper Bessemer built the power element of the gas turbine. The unit runs at a thermal efficiency of 25% on the simple cycle without a regenerator. Gas generator is expected to run at least 8000 hr between overhauls; then it can be removed as a unit and replaced with a new one in less than four hours. Mass production and maintenance of aircraft engines are expected to contribute to low maintenance costs in addition to low initial investment.

Central-station records

The Federal Power Commission reports outstanding records for the year 1959 for utility central stations. Ten best heat rates for the year in Btu per kwhr were:

Dickerson, Potomac Electric Power—9007
Clinch River, Appalachian Power—9011
Kanawha River, Appalachian Power—9098
Silas McMeekin, S. Carolina E & G—9130
Muskingum River, Ohio Power—9170
River Rouge, Detroit Edison—9170
Clifty Creek, Indiana-Kentucky Electric—9173
G G Allen, Duke Power—9174
Tanners Creek, Indiana & Mich. Electric—9176
Shawville, Pennsylvania Electric—9179

The ten largest steam plants in the U.S.A. as of Dec 31, 1959 were, in megawatts:

Kingston, Tennessee Valley Authority—1440
Shawnee, TVA—1350
Clifty Creek, Indiana-Kentucky Elec—1304
New Johnsonville, TVA—1275
C R Huntley, Niagara-Mohawk—1090
Kyger Creek, Ohio Valley Electric—1086
Gallatin, TVA—1050
Joppa, Electric Energy, Inc—1041
St. Clair, Detroit Edison—950
Hudson-Gold, Con Edison of N.Y.—920

Modern aborigines

The Confederated Salish and Kootenai Tribes of the Flathead Reservation in Dixon, Mont. have filed an application with the FPC for a proposed hydroelectric development on the Flathead River. It would have a reservoir about 24-mi long behind a concrete dam and powerhouse with 120-mw capacity, at mile 36.5. A second concrete dam at mile 61.5 would create a reservoir about 12 mi long and feed a second 120-mw power plant.

More engineers and scientists

Study made by the Bureau of Labor Statistics for the National Science Foundation showed that industry employed about 6.7% more engineers and scientists in January 1960 than in January '59. These data were obtained from more than 10,000 companies cooperating in the survey:

Professionals	*Jan 1960*	*Growth, '59-'60*
Engineers	656,300	6.6%
Chemists	159,200	7.6%
Physical scientists	57,100	9.0%
Life scientists	18,800	3.9%
Unclassified scientists	6400	–3.0%

Two industries, electrical equipment and aircraft, each employed about 100,000 engineers and scientists in Jan 1960. Others employing more than 50,000 included chemicals and allied products, machinery and petroleum products.

New high-energy air "super" heater

National Aeronautics and Space Administration (NASA) has awarded a contract to the Westinghouse Electric Corp for a high-energy arc heater. This will supply a 10-minute stream of hot h-p air to a wind tunnel at Moffett Field, Calif. to simu-

late re-entry of missiles and space craft into the earth's atmosphere. For aerodynamic tests the heater will exhaust gas at 1500 psia at 1.16 lb per sec with an enthalpy of 2000 Btu per lb. Air temperature inside the heater will be about 6000 F. The gas will enter the test chamber at speeds of 9 to 12 times the speed of sound and at simulated altitudes above 200,000 ft. For mass-transfer tests the heater will supply air at 0.5 lb per sec at 100 psia and an enthalpy of 10,000 Btu per lb. When air flows through a nozzle its temperature will drop from about 13,000 F to the level needed. Power input to the arc heater: about 10 mw. Heater will run on dc supplied from existing motor-generator sets. An arc struck between doughnut-shaped electrodes is rotated by a magnetic field to prevent electrode erosion and maintain gas purity.

Bituminous-coal market will grow

Bituminous-coal sales will grow by 75% to 735 million tons in 1970, says J R Forsythe of Keystone Coal Buyers Manual, McGraw-Hill. He forecasts that electric utilities will double their coal use to 350 million tons annually; coking plants around the world will increase use of American coal by 50% and other markets will grow by 50%. Within a few years Forsythe expects coal's problems to switch from over to undercapacity. For the '60's, new capacity average of 50-million tons per year will be needed, an investment of over $5 billion.

World's smallest motor

William McLellan of Pasadena, Calif. has built a rotating electric motor less than 1/64th-in. long. You need a 40-power microscope to see it. Only 0.006 in. in diameter, it contains four coils of wire with 21 turns per coil, a quartz bearing, a tiny rotor—13 parts in all. It develops one millionth of a hp. There is no immediate use for the midget, but the builder collected a $1000 prize from Dr R Feynman, of the California Institute of Technology, for its construction. (*McGraw-Hill World News*)

Fresh water from salt

The U.S. Dept of the Interior's Office of Saline Waters has awarded a construction contract to Westinghouse Electric Corp for a 1-million gpd sea-water-conversion plant. The plant will be built at Point Loma near San Diego, Calif. The city will buy the water. The multiflash unit will be one of five demonstration plants to be built in the U.S. This unit is scheduled to be ready in one year. Architect-engineering will be by Fluor Corp; Ralph M Parsons will be in on engineering and construction of the plant.

Richardsons Westgarth have shipped a flash evaporator, 17,250-gpd, to the Sheikdom of Abu Dahbi on the Trucial Coast. The evaporator can float on its own pontoon. Some miles off its destination it will be lowered into the sea and towed to the beach, then winched up the beach onto a concrete foundation. Pontoon will store the fresh water.

Peaking-plant automation

Gulf States Utilities Co has named Allis-Chalmers Mfg Co as prime contractor to install automatic control in the Riverside Power Station at Lake Charles, La. This will be the first computer control installed in an existing plant run for peaking service. Present plant equipment will be extended to allow for computer control. The 70-mw plant will start daily for peaking service during the season. Instrumentation and data-processing equipment will be supplied by Consolidated Systems Corp.

Three McGraw awards given

The National Electrical Manufacturers Assn presented three awards at their 34th annual meeting in New York. Medals and purses commemorate the late James H McGraw of McGraw-Hill Publishing Co. N J MacDonald, Thomas & Betts Co, was cited for leadership in establishing the concept of interdependence in the electrical industry among all its components for the benefit of all. J F Lincoln, Lincoln Electric Co, was cited for "outstanding leadership . . . in creation and development of the electric-arc-welding process." E Morss, Simplex Wire and Cable Co, was cited for "his initiative and leadership in the development of modern synthetic insulation for electrical conductors."

Westinghouse Electric Corporation will design, furnish and erect complete a 350-mw (400-mw peak) capacity gas-fired unit for the Handley Station of the Texas Electric Service Company. The unit spans from the natural-gas inlet to the high-tension switching. It will be built to specifications by Ebasco Services, Inc. United Engineers & Constructors are doing the design and construction for Westinghouse, but Westinghouse will be responsible for design and performance of every piece of equipment and for the entire addition. The unit is scheduled for completion in 1963 to carry '64 peak loads on the Texas Electric system.

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713 Washington St., Kansas City 5, Mo.

For more facts circle 288 on Reader Service card, p 99

Powerscope

Begins on page 144

Nuclear group ESADA formed by N. Y. firms

Seven New York State utilities (1) Central Hudson Gas & Electric (2) Consolidated Edison Co of N. Y. (3) Long Island Lighting (4) New York State Gas & Electric (5) Niagara Mohawk Power (6) Orange and Rockland Utilities (7) Rochester Gas and Electric have formed a non-profit corporation: Empire State Atomic Development Associates, Inc (ESADA). This group has launched a 2-pronged program of investigation to develop a 300- to 500-mwe nuclear power plant that would compete cost-wise with conventional steam plants, now running at about seven mills per kwhr.

Decision to build such a plant may be reached in about three years—if it's favorable, the plant may be running by 1967. ESADA has separate contracts with General Electric Company and the General Atomic Div of General Dynamics Corporation.

General Electric Co will build an $8-million 15-mwt superheat reactor at its Vallecitos Atomic Laboratory in California. The development unit will be ready by July 1962 and is expected to develop 850- to 950-F outlet steam temperatures. ESADA will contribute $5.75 million toward construction of this unit.

General Dynamics will carry out its program at John Jay Hopkins Laboratory in San Diego, Calif. It will carry on $8.7-million research and development of a high-temperature graphite-moderated helium-cooled reactor using graphite-clad homogeneous fuel-moderator elements. ESADA will contribute $4.5 million toward this work. General Dynamics has already done considerable work on this reactor.

National Electrical Week slated—Feb 5 to 11

February 5 to 11, '61 is set aside as National Electrical Week by a committee representing major segments of the electrical industry. Chairman

YOUR CALENDAR OF

MICRO POWER "no-break" POWER EVENTS FOR 1961

..by UNITED STATES MOTORS CORPORATION

1ST QUARTER

New BRUSHLESS GENERATORS

U. S. Motors 5 to 20 kw capacity Micro Power units will feature new "brushless" generators to eliminate brush and slip ring maintenance requirements. The no-break units will also operate at plus or minus 1 per cent voltage regulation to satisfy increasing sensitivity of critical operating equipment.

2ND QUARTER

New 5 KW DIESEL MICRO POWER

5 KW capacity "diesel" Micro Power units will be available to fulfill growing demand for a thoroughly dependable power supply unit of smaller capacity.

3RD QUARTER

New LARGER SELECTION

The most complete selection of Micro Power units ever offered will be ready by the second half of '61. Included will be 1½-3 kw gas, or gasoline units — 5, 10, and 15 kw gas, gasoline, or diesel units — 20, 30, 50, 75, 100, 150, 200, and 300 kw capacity diesel units.

4TH QUARTER

New COMBINATION AC/DC UNITS

For the first time, combination AC/DC Micro Power units will be offered in 3 kw and larger capacities with 48 or 129 volt DC current for energizing transistorized microwave communications equipment, and 120/240 volt AC current for handling non-critical power needs.

GROWING STEADILY TO MEET YOUR MOST CRITICAL POWER REQUIREMENTS

1952
First Micro Power Unit.

1953
Intensified design and testing program initiated.

1954
First shipments of 3 KW gas, gasoline Micro Power.

1955
First shipments of 5 KW gas, gasoline Micro Power.

1956
First shipments of 10 KW gas, gasoline Micro Power.

1957
First diesel Micro Power Unit.

1958
Further expansion of research-testing program. First 50 KW Micro Power Unit unveiled.

1959
First shipments of 10 KW diesel Micro Power. 100 KW unit designed.

1960
Over 2000 units in operation. Larger capacities on the way.

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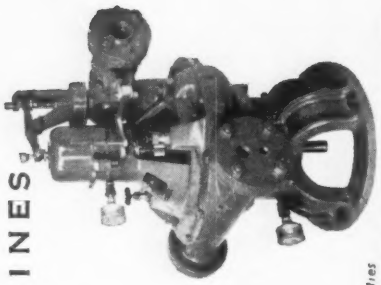

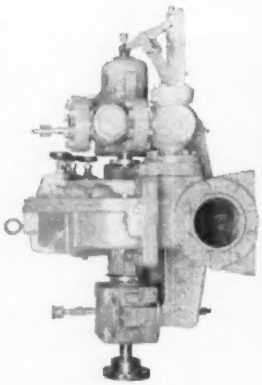

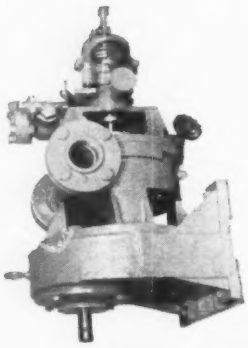

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WRITE FOR BULLETIN 20-C-3

CARLING TURBINES

Circle 290 on Reader Service card, p 99

Begins on page 144

of the industry endeavor H A Webster announced that they've contacted more than 80 companies in an effort to build a strong nation-wide backdrop for the week's activities.

Observance materials will be offered through NEW headquarters—speeches, emblem proofs, pamphlets and display materials. Some special exhibits are being planned by industry groups.

The 1961 Planning Guide gives details of how various groups can plan and carry out their own National Electrical Week observances, available from NEW headquarters, 290 Madison Ave, New York 17, N. Y.

Power's history

POWER was founded in 1884 by E P Harris and H M Swetland. With it was incorporated *Steam* which had been started by N Hawkins in Chicago two years earlier.

In 1903 POWER purchased and absorbed *Science and Industry*, which was a consolidation of a number of periodicals, namely *Home Study Magazine, Home Study for Machinists, Mechanic's Magazine, Home Study for Building Trades, Building Trade's Magazine, Home Study for Electrical Workers* and *Steam Electric Magazine.*

In 1908 POWER absorbed *The Engineer's Review*, of Cleveland, and *The Engineer*, of Chicago, the latter being a consolidation of *The Safety Valve, Lord's Power* and *Machinery Magazine, The Stationary Engineer, Steam Engineering and The Mechanical Engineer.* When *The Engineer* was purchased, the name of the combined magazine was *Power and the Engineer.* The title was condensed to POWER in 1911. In 1951, POWER absorbed *Operating Engineer.* All rights to above titles reserved.

Grid switching station shunting power from the Soviet, Czech Rumanian and Hungarian systems to demand areas is being constructed in Munkacs (Carpato - Ukraine). Deadline is early 1962.

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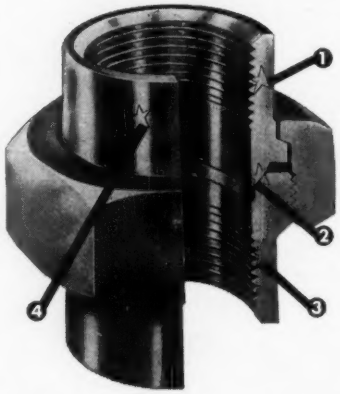

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2. **Catawissa Ball-to-Angle Seats** give you a "Perfect Seal" regardless of pipe alignment!

3. **More than adequate** wall thicknesses give you Catawissa's 3-to-1 Safety Factor (3000-lb. service, 9000-lb. test; 6000-lb. service, 18000-lb. test)!

4. **Round, straight barrels** for fast wrenching. No uneven or tapered surfaces to cause wrench slips or wrench locking!

Catawissa Perfect Seal Pipe Unions are made by Union Specialists from 80,000 lb. tensile strength steel (ASTM Spec. A-105-55T, Grade II). Steel forgings from our own forging mill are closely checked for imperfections . . . and finishing on modern, automatic machines with close inspection during and after production give you pipe unions second to none!

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You don't have to handle Zebra with kid gloves. This multi-layer sectional-type thermal insulation has real body . . . doesn't break easily. In fact, its deflection at breaking point is 2 to 4 times that of ordinary insulation.

A low, medium, and high-*temperature* pipe insulation, Zebra is made in half sections in all pipe sizes to facilitate handling and reduce the number of joints. This, plus its light weight, speeds application and keeps installation cost *low*. Zebra is easy to cut and fabricate. And it's reusable . . . can be dismantled and re-applied.

What's more, Zebra won't cause skin irritation or cuts. It has a smooth surface . . . no ragged ends. And it's practically dust free.

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Keasbey & Mattison at Ambler

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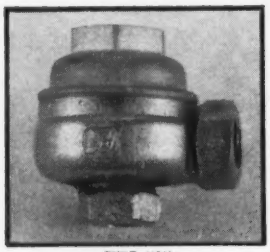
WITH STEAM TRAPS TOO—



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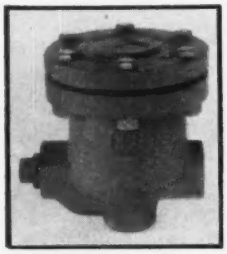
½" & ¾"



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Also available as
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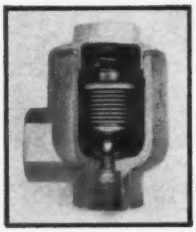

TYPE "S"
Cast bronze bodies.
0-250 PSIG.
½" through 1"

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Because you wanted the many advantages of thermostatic traps — high air and water capacities, simplicity, single orifice size over full pressure range, the ability of repairing and maintaining right on the line with a minimum of shutdown time and labor cost, plus dependable uniformity of operation obtained by calibration. Calibration permits use of a **one-piece interior** that makes the dream of simplified maintenance come true.

WHAT IS INSIDE THE B&J STEAM TRAP

A one-piece operating mechanism. A "Trap Within A Trap." All working parts of the B&J trap, bellows, plug **and seat** are locked in calibration inside a stainless steel cage which is completely independent of all tolerances in trap body and cover. **Not** a collection of parts to install, but a **single** piece to drop in while the trap is on the line.

CAGE UNIT
One-piece trap interior. Monel Bellows, Stainless Steel Plug & Seat. Calibrated for sensitivity.

SEE THE LATEST DEVELOPMENTS IN STEAM TRAPS AT BOOTH NO. 947, NATIONAL PLANT MAINTENANCE AND ENGINEERING SHOW, CHICAGO, JANUARY 23-26, 1961.

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For more facts circle 293 on Reader Service card, p 99

Calendar

Jan 17-19, 1961 — Instrument Society of America, Winter Instrument-Automation Conference and Exhibit, Sheraton-Jefferson Hotel, Kiel Auditorium, St. Louis, Mo. Details: Meetings Services Dept, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

Jan 17-18—American Society of Lubrication Engineers, Bearing Symposium, Penn-Sheraton Hotel, Pittsburgh, Pa. Details: C L Willey, 84 E Randolph St, Chicago 1, Ill.

Jan 18—Metallurgical Society of AIME, Conference on Bar and Allied Products, Penn-Sheraton Hotel, Pittsburgh, Pa. Details: Metallurgical Society of AIME, 29 W 39th St, New York 18, N. Y.

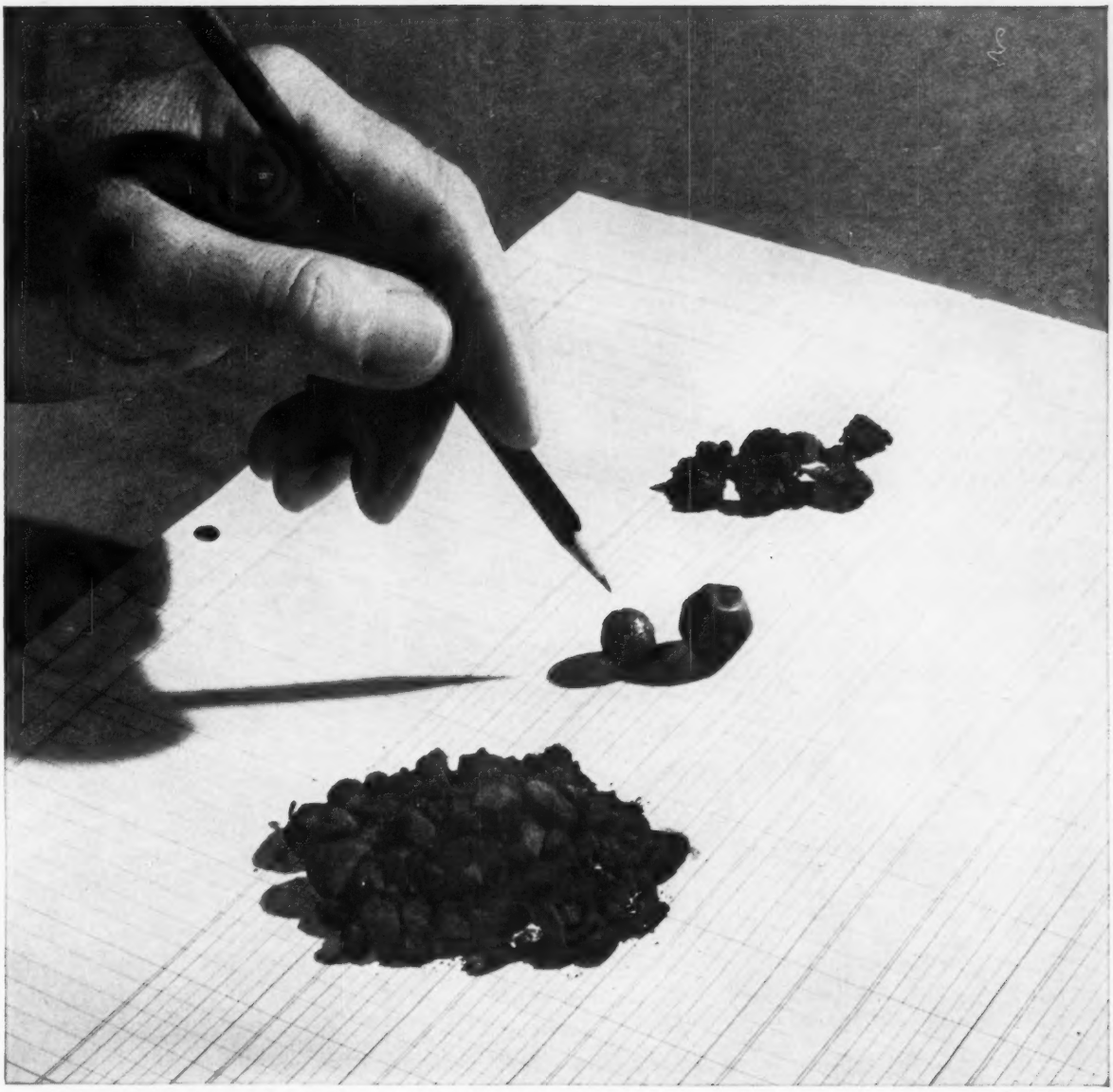
Jan 23-26—Plant Maintenance and Engineering Show, International Amphitheatre, Chicago, Ill. Details: Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N. Y.

Feb 13-16—American Society of Heating, Refrigerating and Air-Conditioning Engineers, Semi-Annual Meeting, 15th International Heating & Air Conditioning Exposition, International Amphitheatre, Conrad Hilton Hotel, Chicago, Ill. Details: E K Stevens, International Exposition Co, 480 Lexington Ave, New York 17, N. Y.

Feb 19-23 — American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, Chase & Park Plaza Hotels, St. Louis, Mo. Details: AIME, 29 W 39th St, New York 18, N. Y.

Feb 20-23—Technical Association of the Pulp and Paper Industry, 46th Annual Meeting, Hotel Commodore, New York, N. Y. Details: E N Wark, TAPPI, 360 Lexington Ave, New York 17, N. Y.

Feb 26-March 1—American Institute of Chemical Engineers, Meeting, Roosevelt Hotel, New Orleans, La. Details: AIChE, 25 W 45th St, New York 36, N. Y.



Specimens of copper powders, balls and balled sheets which can be removed from high-pressure boilers by the M-50 treatment.

M-50 REMOVES THESE COPPER TROUBLEMAKERS FROM BOILERS, FAST!

The M-50 single-stage, patented treatment* for high-pressure boilers removes copper deposits and other scales in record time. With this exclusive Dow Industrial Service treatment, copper does *not replate* on clean boiler surfaces during treatment, and small quantities of M-50 in future cleaning will help *keep* boilers copper-free. To date, the M-50 treatment has cleaned more than 300 boilers.

Copper deposits, common in many high-pressure boilers, reduce heat transfer efficiency and cause localized corrosion, overheating and subsequent ruptures. Copper particles slough off, reducing circulation.

Dow Industrial Service developed the M-50 treatment to remove troublemaking copper and other deposits at the same time. In cases of excessive metallic copper deposits, a preliminary treatment may be desirable.

D.I.S. cleans all kinds of equipment . . . boilers, process equipment, pipelines, water wells, to name a few . . . for every kind of industry. With many methods to choose from, D.I.S. engineers first analyze each job to pick the technique best suited to the specific problem.

D.I.S. also offers complete consulting laboratory service for water treatment and waste processing, backed by the technical resources of The Dow Chemical Company. For fast "total" cleaning of any industrial equipment, anywhere in the U.S.—and for literature on copper removal by the M-50 treatment—write or call DOW INDUSTRIAL SERVICE, 20575 Center Ridge Road, Cleveland 16, Ohio. **Patent No. 2959555*

DOW

DOW INDUSTRIAL SERVICE • Division of The Dow Chemical Company

For more facts circle 294 on Reader Service card, p 99

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Types of motors available and what makes them tick. Also comprehensive, easy-to-read discussion on major new developments in enclosures, ratings and insulation. Thoroughly illustrated; 32 pages. *Per Copy, 75¢.*

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Appointments

Awards

V D Perry, vice-president and chief geologist of The Anaconda Co, the Jackling Award by Society of Mining Engineers.

Institute elections

Willis F Thompson

United Engineering Trustees, Inc announces election of Willis Thompson as president of the organization. He replaces Andrew Fletcher, chairman of the board of directors of St. Joseph Lead Co and former president of AIME.

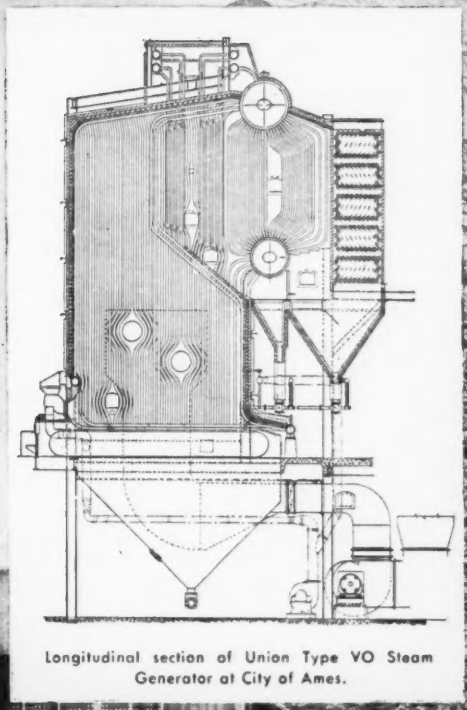
An executive vice-president of Westcott and Mapes, Inc and former vice-president of ASME, Thompson has been director of the Engineering Foundation and a member of Engineers Council for Professional Development. The organization's new vice-presidents are J F Fairman, senior vice-president of Consolidated Edison Co, representing AIEE, and L C Kemp Jr, vice-president of Texaco, Inc, representing AIChE.

UET is an organization of five major national engineering societies, AIME, ASME, AIEE, AIChE and ASCE.

Air-Conditioning and Refrigeration Institute: R K Serfass, manager of Westinghouse Electric Corp Air-Conditioning Div, president. **American Institute of Electrical Engineers:** H K Sheppard, vice-president, Utilities and Power Dept of Rumsey Electric Co, vice-president. **American Institute of Mining, Metallurgical and Petroleum Engineers:** R R McNaughton, manager of the Metallurgical Div of The Consolidated Mining and Smelting Co of Canada, president.

Foundation for Instrumentation Education & Research: Dr I M Stein, president of Leeds & Northrup Co, president. **The Metallurgical Society of AIME:** J S Smart Jr, general sales manager of the American Smelting and Refining Co, president. **National Electrical Manufacturers Association:** A D R Fraser, president of Rome Cable

FUEL SAVINGS 16%



Longitudinal section of Union Type VO Steam Generator at City of Ames.

JOB: Includes delivering steam for a 12,650 KW Turbo-generator in Municipal Power Plant, City of Ames, Iowa.

STEAM GENERATOR: A Union Type VO Single-Pass (140,000 lbs./hr., 630 psi, 825° F). Fired by continuous ash discharge spreader stoker. Equipped with extended surface economizer for heat recovery. Selected for its adaptability to multi-fuel firing.

RESULTS: In continuous operation for six months, supplying total steam requirements, the Union VO was credited with fuel savings of 16%.

MORE INFORMATION: Many types and sizes of Union Steam Generators are described in illustrated Bulletin GB-959. Write: Union Iron Works, Division of Riley Stoker Corp., Erie, Pennsylvania.

UNION

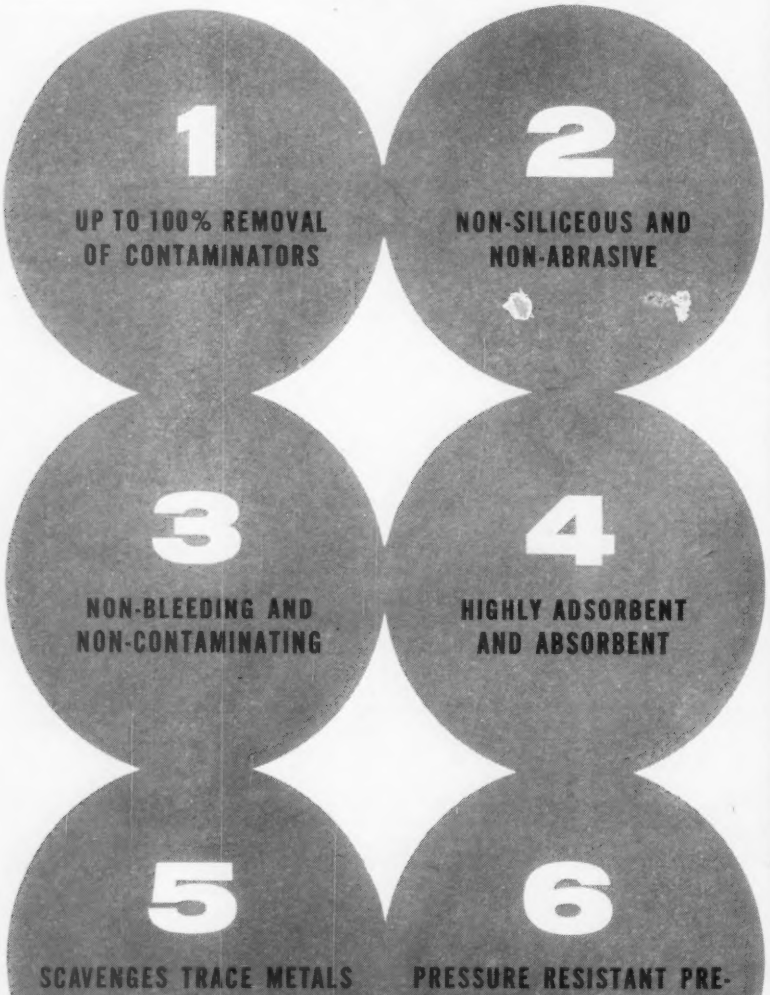
steam generators

For more facts circle 296 on Reader Service card, p 99

SOLVE CONDENSATE CONTAMINATION

with newest, super-efficient filter aid

SOLKA-FLOC® High steam pressure condensate contamination is often a serious and trouble-causing problem. Solka-Floc, basically different than other filter aids, removes up to 100% of contaminators—metallic ions, suspended solids, emulsified oil. It provides effective and economical filtration.



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Appointments

Begins on page 152

Div of Aluminum Company of America, president. **National Insulation Manufacturers Association:** H T Williams, manager of engineering and industrial sales, Owens-Corning Fiberglas Corp, president. **Society of Mining Engineers of AIME:** J C Gray, administrative vice-president of raw materials, U. S. Steel Corp, president.

Obituaries

Arthur Cecil Roe

Staff engineer of National Industrial Service Association, Inc, widely known author of textbooks and magazine articles on electric motor repair, Arthur C Roe died on Oct 10 at the age of 69.

Beginning his career with Westinghouse Corp in 1912, Roe moved on in 1938 to become associated with National Industrial Service Association as staff consulting engineer.

H Stanley Ford, vice-president and general manager of the Bigelow-Liptak Corp, at the age of 67.

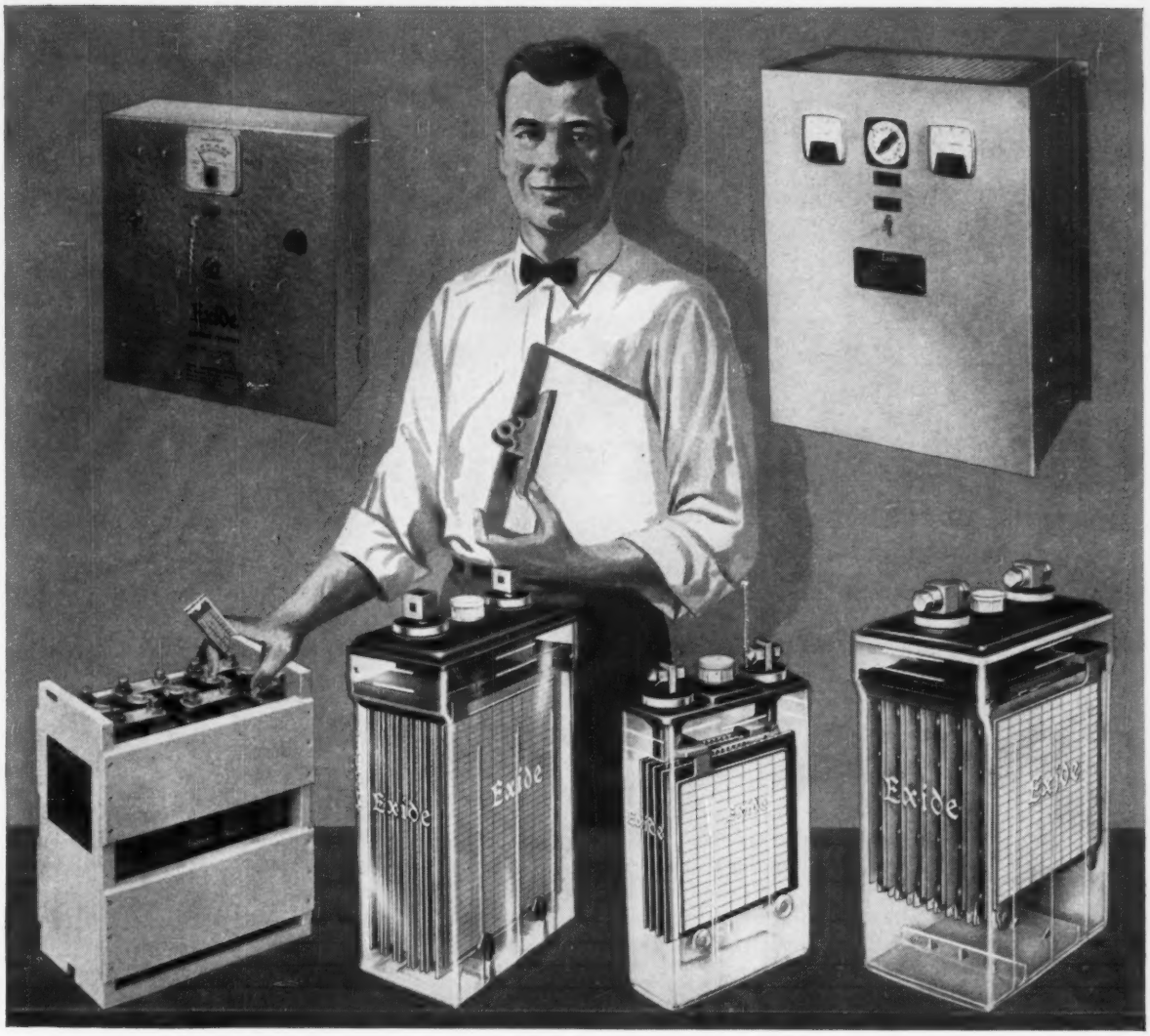
Frederick G Merckel, director and retired president of Wallace & Tiernan Inc, at the age of 64.

T G A Sillers, manager of Allis-Chalmers Manufacturing Co power-systems engineering dept. He was 57.

Ormrud Titus, president of the Metropolitan Edison Co, at the age of 67.

Correction

Instrument Society of America will meet at the Shamrock-Hilton Hotel, Houston, Texas, on April 17 for their 7th National Symposium on Instrumental Methods of Analysis. POWER mistakenly listed Veterans Memorial Auditorium, Columbus, Ohio.



Exide determines the best battery type and charger for you by studying your particular duty requirements

Selecting a battery and charger today is really an engineering job. Each application has its own requirements. That's why Exide offers a variety of batteries and chargers—in fact the broadest in the field. It means you can buy the type battery and charger you should have. Because Exide has no ax to grind for any particular type, you can expect an unbiased recommendation.

The battery line includes (1) flat plate Tytex with Silvium;* (2) flat plate Tytex with calcium; (3) long-life Exide-Manchex—Planté type—with Silvium; (4) low-maintenance pocket positive nickel-cadmium; (5) new 20-year Exide-Ironclad tubular with Silvium. The charger line includes (1) constant voltage type; (2) trickle or Hi-Lo type. You get Exide quality and value on all.

An Exide power package lets you buy with confidence. Exide service—the quickest, most dependable you can get—covers battery and charger. For complete information, write Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

*Silvium is Exide's patented corrosion-resistant grid alloy

Exide®

INDUSTRIAL MARKETING DIVISION (ESB)
The Electric Storage Battery Company

For more facts circle 298 on Reader Service card, p 99

George Edwards

reminds: You never get something for nothing

I'll probably stir nostalgic memories among those of you who were raised on a farm, as I was, when I recall such activities as "threshing time," "apple picking" and "hog killing." We kids looked forward to these with mouth-watering anticipation as farmers gathered at each other's places to get the jobs done. Their wives, taking over in the kitchens, would turn out a steady stream of fried chicken, roast beef, baked hams and all sorts of pies, cakes and cookies. Out of the storage cellars came a myriad of pickles, relishes, fruit butters, jams and jellies. We kids would eat ourselves into a stupor, recuperate enough to play until we got hungry, then start all over again. But as we grew older and shouldered part of the job we learned the meaning of hard work; these feasts were no more than much-needed refueling stops.

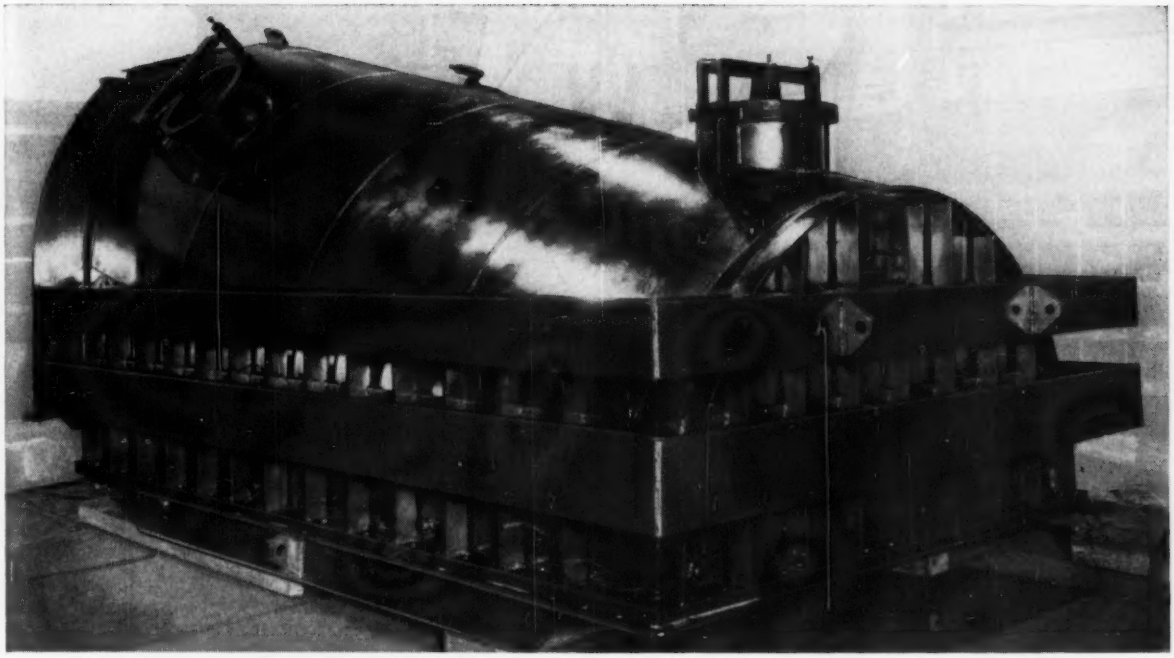
The help usually included a few local guys who went from place to place to pick up a few bucks "by the day." I guess they were the early, if not the original "part-time" employee that is so common now. And today, as then, we pay just for the time they work for us. This goes for equipment rental, too, which is big business these days.

Renting equipment or hiring people on a part-time basis is smart procedure in many instances, because we don't have to assume full employer or ownership responsibilities. But it's surprising how many people *have* full ownership responsibility and full-time expenses, yet only get part-time service in return. How can this be? I'll give you a typical example I saw just a few weeks ago. And I'll bet a lot of you have run into the same sort of thing.

A friend of mine I'll call Dick Mathews is maintenance superintendent for a fair-sized process plant. I found him staring moodily at a dismantled solenoid valve spread on his desk. "One of the men just brought this in to show what fouled us up." Dick jabbed at the valve stem with a pencil. "The disk simply dropped off the stem and, presto, no control on a chilled-water line. Valve's less than a year old, too."

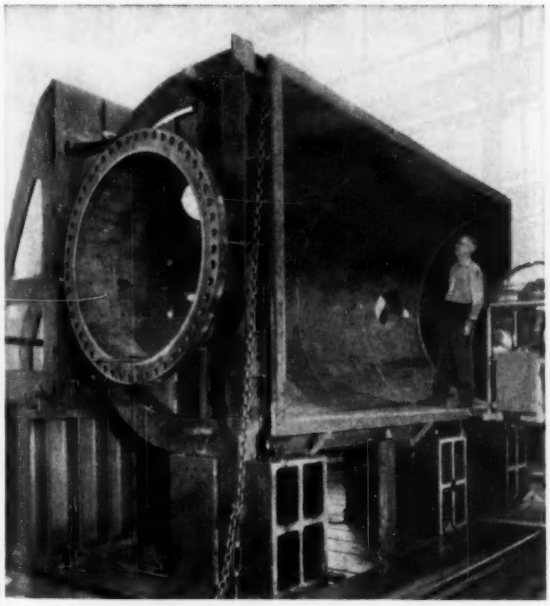
Dick lit a cigarette, his hands trembling just a little. "The brass bought this system for a real nice price—they think. It's supposed to supply 40-F water for process and air conditioning for certain areas. The contractor must have worked hard to find all the off-brand instruments that go haywire all the time. Tough part is, *we're* blamed for not knowing how to keep the system on the job. And this is typical of what we're up against with a lot of equipment here. I'm about ready to throw in the towel."

Dick Mathews didn't beef to me about his job or poor working conditions in the ordinary sense. Here was a conscientious engineer prevented from doing a good job because of management's penny-wise pound-foolish practice in selecting equipment. And what Dick told me is exactly what Lou Rowley was talking about in his editorial last September (*Lowest price—highest cost,* p 63). Aside from equipment's poor-part-time-performance costs, how much does it cost to lose a Dick Mathews who either quits the job—or quits caring?



COMPLETED AMBRALOY WATER BOX, one of eight, for 198,000-sq.-ft. twin-shell condenser in Consolidated Edison Company's Astoria No. 4 Unit. Boxes fit on tube sheets of Everdur—each 8′ x 14′ x 1½″—produced by Anaconda American Brass Company. Box is stiffened by steel ribs welded to the shell and to two heavy steel reinforcing bars.

New long-life water boxes fabricated from Ambraloy improve water flow—are ⅓ weight of cast boxes



WATER BOX ON A VERTICAL BORING MILL during construction at C. H. Wheeler Mfg. Co. plant, Philadelphia. The shell is fabricated from hot rolled Ambraloy-930 plate, ⅜″ gage throughout. At main seams, segments are prebeveled by grinding and joined by butt welding. Fillet welds are used to attach inlet nozzles, manholes, vents, and stiffener ribs. Most of the welding was done by the inert-gas consumable-electrode process; inaccessible joints were made by manual metal-arc welding with flux-coated electrodes.

Streamlined water boxes built by C. H. Wheeler Mfg. Co. for Consolidated Edison Astoria Unit No. 4

Fabricated from a strong wrought copper alloy, they offer some interesting advantages over cast iron boxes.

1. Weight savings—under 17,000 pounds compared with 45,000 pounds for cast boxes—easier to ship and handle in installation and maintenance.

2. Wider latitude in water box design. Conical shape of boxes streamlines flow of cooling water, minimizing turbulence and eddy currents which affect tube life.

3. Long service life. Unlike cast iron boxes, which rust and leave corrosion products detrimental to tubes and tube sheets, nonferrous boxes are highly corrosion resistant.

Engineers at C. H. Wheeler Mfg. Co. consulted Anaconda metallurgists for suitable alloys combining high strength, weldability, and high corrosion resistance. The relative merits of Cupro Nickel, 10%-755, used for water boxes in Naval condensers, Ambraloy-930 (aluminum bronze) and Everdur®-1010 (copper-silicon alloy) were considered, and as a result Ambraloy-930 was selected for this particular installation handling polluted sea water from New York's East River.

Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 6067

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Anaconda American Brass Company

WHAT'S YOUR PROBLEM?...

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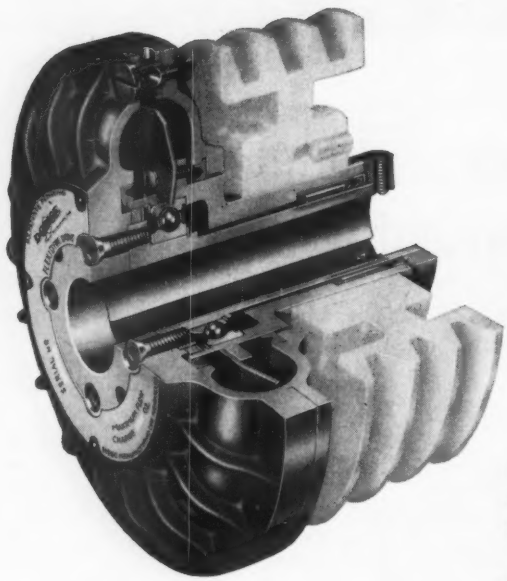
- ☑ Excessive belt maintenance?
- ☑ Breakage of materials being processed —like thread, wire, paper?
- ☑ Expense of oversize or high torque motors?
- ☑ High demand rate?
- ☑ Expense of reduced voltage starters?
- ☑ Clutch trouble?
- ☑ Breakage of transmission parts due to instantaneous shock loads?
- ☑ Damage and recurring down-time from overloads?



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It is no longer necessary to accept the destructiveness—the costliness—of conventional starting in the mechanical transmission of power. Flexidyne changes that!

Flexidyne is the new way to start loads *smoothly*—to protect against shock and overload—to save power—all *without any sacrifice of efficiency at full load!*

This revolutionary development is ushering in "the day of the soft start"—which can mean thousands of dollars to you in equipment savings and in better, more economical operation.

Flexidyne is available, off the shelf, in Drives and Couplings. Capacities range from fractional to 1,000 hp. Ask your local Dodge Distributor or write us for technical bulletin.

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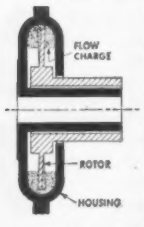
HOW FLEXIDYNE WORKS



The "dry fluid" in Flexidyne is tiny heat-treated steel shot. A measured amount, called the "flow charge," is contained in the housing, which is keyed to the motor shaft. Inside the housing is a rotor, free to revolve relative to the housing, but connected to the load.

When the motor is started, centrifugal force throws the flow charge to the perimeter of the housing, packing it between the housing and the rotor, which transmits power to the load. Initial slippage is momentary. Housing and rotor become locked together and achieve full load speed without slip and at 100% efficiency.

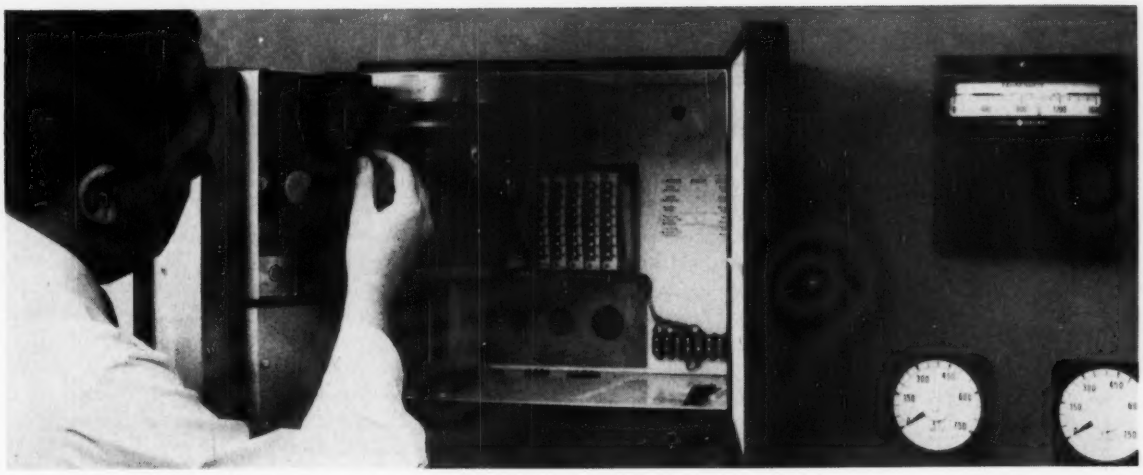
CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the *white* pages of your telephone directory, or in the yellow pages under "Power Transmission Machinery."

DODGE

of Mishawaka, Ind.

Plant maintenance and management section

STEVE ELONKA
Associate Editor in Charge



INSTRUMENT MAINTENANCE depends upon knowhow of individual personnel to deliver maximum instrument performance at low cost

Greater and greater portions of plant cost are invested in instruments and controls. To make this investment pay off engineering management must . . .

Organize instrument maintenance programs for effective work

By V F TERRY, Product Service Specialist, and
C A MATTOON, Field Engineer
General Electric Company
Instrument Dept, West Lynn, Mass.

Increasing automation of industrial production has also increased the need for good in-plant instrument-service organizations. For all instruments require periodic service and maintenance to realize their optimum performance at reasonable cost. Often this important function does not receive the serious planning it deserves. Sometimes too little thought is applied to the broad aspects of the problem of instrument servicing—technician training or the proper methods of handling paper work—requiring later reorganization and scrapping of much initial effort.

In the process of operating our company's extensive service organization we have an opportunity to visit many plants and to see many maintenance programs in operation. To help you get the greatest return from your maintenance dollar, we would like to pass on some of the best program details we have seen, together with our own suggestions for planning and implementing an instrument-service organization.

Extent of any program depends on such factors as type of business, size, complexity of instrumentation requirements, number of personnel. Don't take this article as a blueprint but rather a helpful guide to stimulate your own creative thinking in planning such an organization.

Primary objective of an instrument-service organization is a definitive program of instrument servicing. Disregarding initial cost of instrumentation, there still remains an incontrovertible fact: quality and resulting profitability of the product is directly dependent on the accuracy and reliability of the instruments used.

High standards of product quality and uniformity de-

Effective maintenance requires knowledge of instruments,

mand good instrument service. A mediocre service program results in lower product quality. Continued to its ultimate conclusion, it will place the business in a precarious competitive position. Industrial instrumentation in particular requires good maintenance and repair facilities. As instruments continue to exert more and more control over manufacturing processes, it becomes more important that the instrument-service facilities keep pace. A good organization will recognize and work to accomplish this.

Importance of the responsibilities delegated to an instrument-service organization *demands* that it have an identity. It must have a descriptive title and charter to completely identify its character, objectives and responsibilities. If it lacks identity and becomes merely one of the functions of an already busy (and probably overloaded) plant electrical-maintenance unit or other group, accuracy and dependability of plant instrumentation may suffer.

Normally, the operation should be functionally responsible to the plant manager of engineering. The supervisor should be a technical engineer specializing in instrumentation or an equally qualified person, and should be responsible for quality of service provided.

Number of instrument technicians required and their technical level of ability will depend on the quantity and complexity of instruments to be maintained. In plants with many instruments it may also be desirable to have several technician specialists.

Instrument technicians will need an electronics background as well as general instrumentation knowledge. The ideal type of instrument serviceman is one whose hobby is perhaps ham radio communications or one who enjoys tracing through complex electric circuits for the pleasure of accomplishment. To such a man, an instrument troubleshooting problem represents a challenging opportunity. Instrument troubleshooting and maintenance is a fascinating field to those whose interests lie in that direction. If personnel of this type are selected to man the instrument-service organization, the company of which it is a part will have fewer problems.

First responsibilities of an instrument-service organization are control of installation, functional operation and maintenance of all indicating, transmitting, recording and controlling devices associated with measurement and control of process variables.

This group also must recommend instrumentation to improve product quality, reduce operating costs, eliminate lost production time and reduce instrument-maintenance costs. To help formulate recommendations, suitable records of instrument performance must be maintained. These should include original investment and a complete history of maintenance costs to provide a means of fairly evaluating each instrument for other similar applications.

As a minimum requirement, instrument record-card files should consist of an "original" record card, a "service" record card, calibration tags for each instrument. Typical cards for these purposes appear at right.

A file should also be established containing installation and other drawings pertinent to the particular instrumentation system. It helps to have instrument identification numbers noted on each drawing as they appear on record cards. The file should also contain manufacturers' maintenance and servicing instructions, renewal-parts publications, manufacturers' catalogs and any special information acquired through experience. In addition to manufacturers' publications, include a small library of technical reference books covering many aspects of instrument operation and servicing, plus various trade journals devoted to instrument-servicing techniques.

Employee training is a major requirement of an instrument-service organization. In addition to having the necessary technical background, today's service technician needs specialized training—available from most large instrument manufacturers. Whenever possible, instrument-service personnel should be sent to manufacturers' customer-training schools. For needed practical experience, assign novices or apprentices to assist experienced personnel in troubleshooting and repair.

The most important aspect in planning an instrument-service organization consists of determining the extent of routine or preventive maintenance. Too little results in expensive special repairs, costly shutdowns, loss of production. If too much is done the operating overhead gets out of line. If the organization has just been formed, it is best to follow instrument manufacturers' recommendations. These, of necessity, are usually general in nature. They can be modified as experience increases.

A work-order program should be developed arranging for periodic inspection and calibration checks of each instrument. The schedule should be planned to allow time for emergency troubleshooting and maintenance problems which may arise.

Evaluate each instrument for critical maintenance requirements and provide for immediate availablity of all critical parts. Often it will be desirable to provide complete standby instruments. Various instrument manufacturers provide recommendations for spare parts and standby equipment including expendable items. A further source of information on which to base a spare-parts program is an analysis of past service records, if available. Regardless of the source of the information, a spare-parts and standby-instrument program is a necessity to the instrument-service organization.

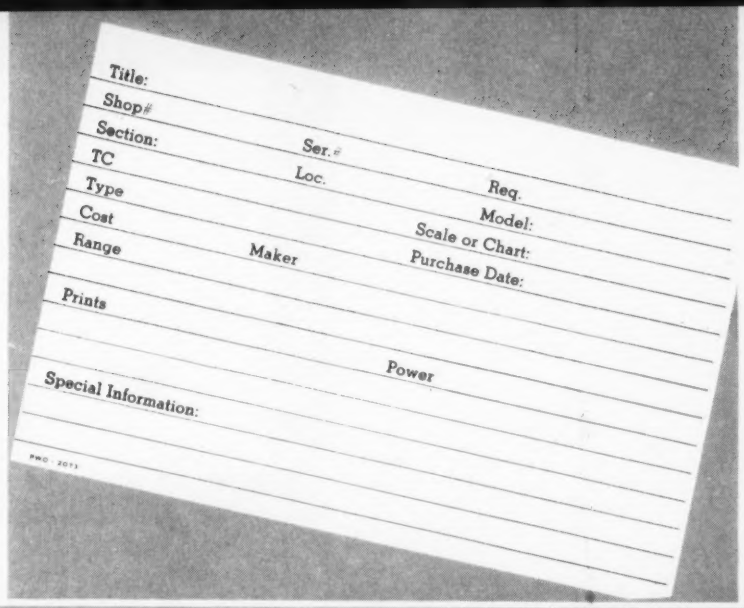
One last but very important aspect of maintenance: availability of service from manufacturers. No matter how self-sufficient an instrument-service organization becomes, need inevitably arises for assistance from manufacturer's service operation.

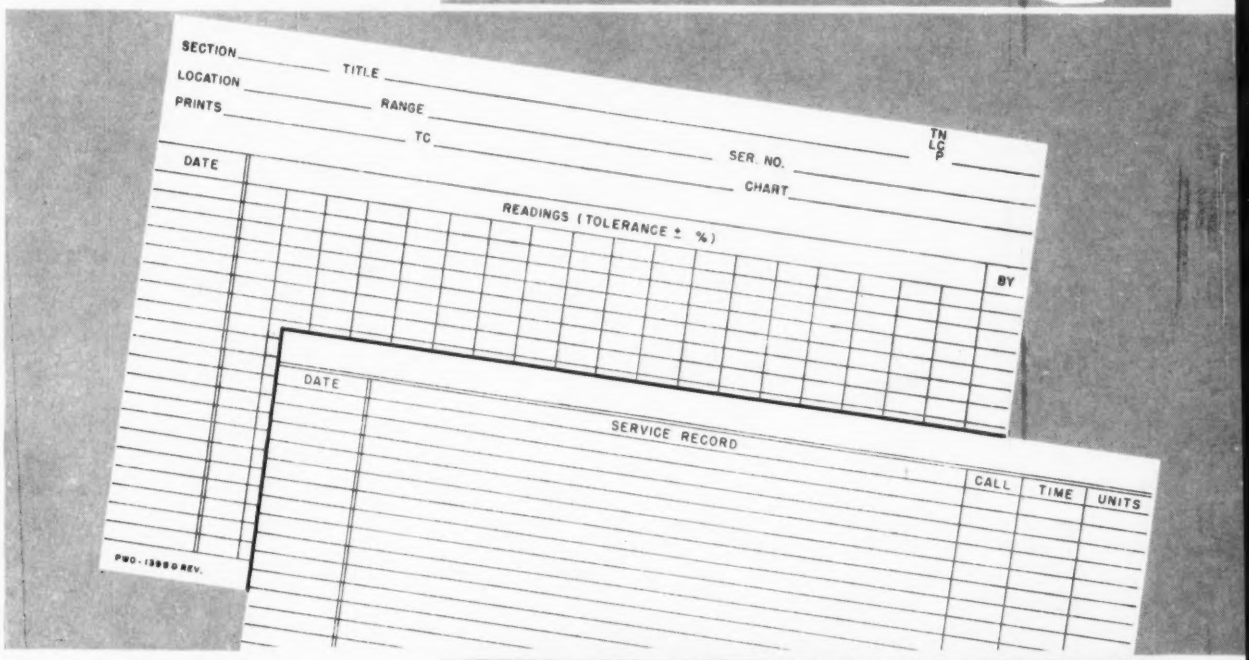
In the final analysis, as in all human enterprises, successfully meeting your objectives depends on the leadership and individual contributions of the collective group. A good instrument-service organization is the sum total of the efforts of the group.

Part 2 of this article will cover tools and test equipment required for effective instrument maintenance.

complete data records

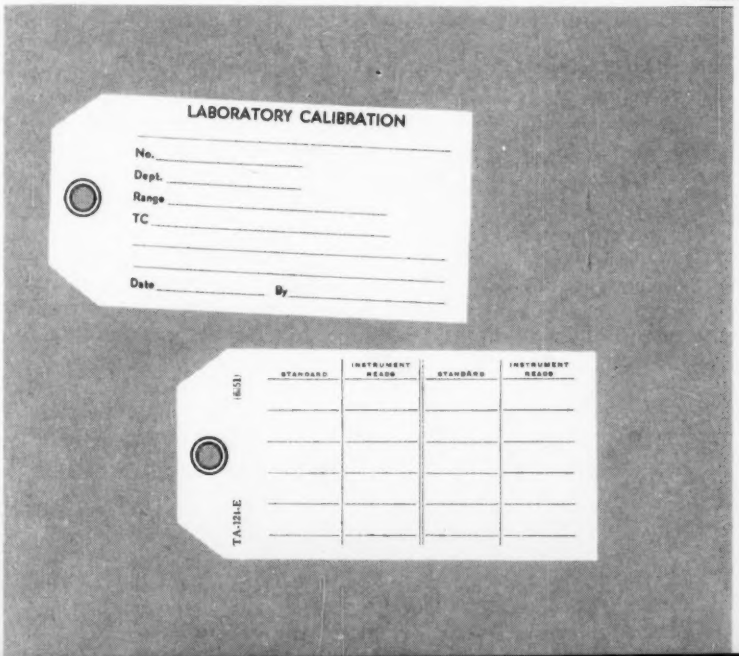
ORIGINAL RECORD CARD serves as base for detailed instrument file. Card should include serial number or other identification, location of the instrument, rating information, a brief description of instrument, all purchase and cost information such as original requisition number, model number, etc, renewal-parts information, servicing instructions, manufacturer's publication numbers, and any special information of future value. Include in the last group drawing numbers for blueprints indicating location and showing connection and function in overall unit control system



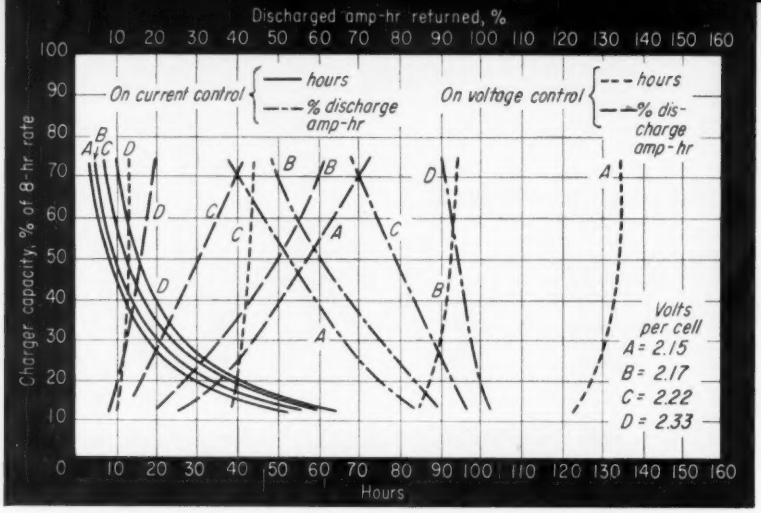


SERVICE RECORD CARD duplicates information appearing on original card where info is of value for service reference. In addition this card should contain records of all service performed on the instrument. Services can be coded in suitable form for automatic sorting and tabulating equipment. Such a system makes instrument information immediately available for reference, evaluation of long-term performance, recommending new equipment

INSTRUMENT-CALIBRATION TAG becomes part of record which stays with the instrument as an indication of current deviation and a log of calibration drift. Since tags may be exposed to oil, dirt and water, spray coating after calibration is recorded will permit easier reading if data is needed later on. With large, cased instruments tags are in less danger of being lost if wired inside the case



By EARLE A HOXIE,
The Electric Storage Battery Co


Discharged amp-hr returned, %
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160
Charger capacity, % of 8-hr rate
100 90 80 70 60 50 40 30 20 10 0
On current control
hours
% discharge amp-hr
On voltage control
hours
% discharge amp-hr
Volts per cell
A = 2.15
B = 2.17
C = 2.22
D = 2.33
Hours

3 Charger capacity affects recharge time on current and voltage control. Batteries with lead-antimony grids were discharged 100%, recharged 110%. Sp gr was 1.210

Last month we considered several important factors in charging at constant potential. Now let's examine partially discharged batteries, effects of grid alloys and . . .

How to charge lead-antimony batteries

Before we get into a discussion of charging lead-antimony batteries in particular, let's see what is involved in charging partially discharged batteries, look at the effect of grid alloys in general on charging characteristics.

If a battery discharges only a portion of its 8-hr capacity, voltage required for a given charge current at the start of the charge will be higher than for a battery that has discharged 100% of its 8-hr capacity. In other words, the counter emf of a cell is higher when battery is at a higher state of charge.

Difference between charging voltage for partially discharged batteries at the start of the charge and charging voltage of a normal fully discharged cell is not considerable—probably not as much as you might expect. But this difference is enough to quite appreciably affect the current taken at a given voltage. Considering the current taken when the battery's 8-hr capacity is fully discharged as 100%, current taken by partially discharged batteries may be roughly stated as: 100% discharge, 100%; 50% discharge, 60 to 80%; 10% discharge, 35 to 50%.

Currents at the start of a charge vary for a given charge voltage. If the cell is placed on charge immediately following a discharge, starting current will be higher than after the battery has been on open circuit for several hours. Rate of the previous discharge also affects the starting current: the higher the preceding discharge rate, the higher the starting current on charge.

Regardless of battery's state of charge and value of the starting current at the start of the charge, charging current and voltage at the end of the charge are the same.

Lead alloy used in battery grids affects the charging characteristics of the cells. Batteries belong to two general groups: (1) cells use grids which are primarily lead antimony but may include small amounts of other metals —silver, tin, arsenic and cobalt (2) cells have lead-calcium grids. For simplification we'll call these groups lead antimony and lead calcium.

Discharge characteristics of the two groups are identical. When batteries are placed on charge, however, lead-calcium batteries develop a higher counter emf, which means charging current at a given voltage and state of charge is somewhat lower for lead-calcium than for lead-antimony batteries.

Floating current required to keep lead-calcium cells at full charge is on the order of ¼ to 1/3 of what lead-antimony cells need, but it's usually necessary to float lead-calcium cells at a slightly higher voltage. They'll often need 2.17 volts per cell, compared to 2.15 volts for lead-antimony cells—we won't consider less than 2.17 volts per cell for lead-calcium batteries. Because lead-calcium cells take lower currents at the same charge voltages, they need a longer time to charge at a particular voltage.

Hours required to recharge lead-antimony batteries

Charger capacity, % of battery's 8-hr amp rate	Constant potential volts per cell	10% discharged				50% discharged				100% discharged			
		Amp-hr returned, %				Amp-hr returned, %				Amp-hr returned, %			
		90	100	105	110	90	100	105	110	90	100	105	110
12.5	2.15	6.0	8.4	12.1	18.4	29.5	39.7	58	89	58	76	110	177
12.5	2.17	5.8	7.2	9.7	14.4	28.8	35.4	48	69	58	70	94	142
12.5	2.22	5.8	6.5	7.6	10.1	28.8	32.6	38	49	58	66	76	100
12.5	2.33	5.8	6.4	6.8	7.6	28.8	32	34	38	58	64	67	75
25	2.15	3.8	6.2	9.8	16.2	17.6	27.8	46	77	32.4	50	85	151
25	2.17	3.2	4.6	7.2	11.9	15.4	22	34	56	30	43	66	114
25	2.22	2.9	3.5	4.6	7.1	14.4	17.4	22.6	33.7	28.8	35.2	46	69
25	2.33	2.9	3.2	3.5	4.3	14.4	16	17.9	21.6	28.8	32.1	35.4	43
40	2.15	3.2	5.5	9.2	15.5	14.0	24.2	42	74	24.7	44	78	145
40	2.17	2.4	3.9	6.4	11.1	12.1	18.7	30.9	53	21.2	34	57	105
40	2.22	1.8	2.4	3.5	6.0	9.1	12.0	17.2	28.3	18.2	24.2	34.7	51
40	2.33	1.8	2.0	2.3	3.1	9.0	10.1	11.8	15.5	18.0	20.3	23.6	31
75	2.15	2.9	5.3	9.0	15.3	12.1	22.4	40.6	72	20.0	37.8	72	139
75	2.17	2.2	3.7	6.2	10.9	8.8	15.4	27.6	49	15.5	28.7	52	100
75	2.22	1.2	1.8	2.9	5.4	7.8	10.6	15.8	26.9	11.0	17.0	27.4	51
75	2.33	0.96	1.15	1.47	2.24	4.8	5.8	7.4	11.2	9.6	11.5	14.8	22.2

Lead-antimony batteries. Let's first consider percentage of charge on current and voltage control.

As we mentioned last month, initial current taken by a battery when placed on charge following a discharge will, in practically all cases, exceed the current that can be supplied from a constant-potential charger. Charger's current-limiting feature, protecting it against overload, is in effect until demand for current reduces to a value that can be furnished by the charger.

Fig. 3 shows percentage of discharged amp-hr returned to a discharged lead-antimony battery on current control (assumed constant current) and on voltage control (constant voltage) for chargers with current ratings from 12.5% to 75% of battery's 8-hr amp rating. Hours on current and on voltage control are also indicated. For example:

A 4-amp charger used with a 100-amp-hr-capacity battery (12.5 amp for 8 hr) has a capacity equal to 4/12.5 or 32% of battery's 8-hr rate. Fig. 3 indicates that if a battery is being recharged after a discharge equal to 100% of its 8-hr amp-hr capacity from a 4-amp charger, adjusted to maintain a constant potential of 2.15 volts per cell, about 65% of the discharged amp-hr will be returned to the battery in 16.25 hr under current control at 4 amp. For a 10% amp-hr overcharge the remaining 45% will be returned at a constant potential of 2.15 volts per cell in an additional 131 hr.

If the same 4-amp charger (32% of the battery's 8-hr amp rate) is adjusted to hold a constant potential of 2.33 volts per cell, Fig. 3 shows that 98% of the discharged amp-hr will be returned in 24.5 hr on current control; remaining 12% will require an additional 11 hr at the constant potential of 2.33 volts per cell.

Table, above, shows effect on time required for charging lead-antimony batteries with charge voltage limited to values of 2.15, 2.17, 2.22 and 2.33 volts per cell. Batteries are charging from constant-potential chargers with capacities equal to 12.5, 25, 40 and 75% of batteries' 8-hr amp capacity. Times needed to replace 90 and 100% have been included as well as times to replace 105 and 110% of discharged amp-hr.

Note relatively long time needed to return 105 or 110% of discharged amp-hr compared with 90 or 100%. Note also that recharge time at higher charging voltages depends on charger capacity. Increasing capacity doesn't reduce charging time proportionally. Also, as charge voltage drops, reduction in recharge time resulting from increased charger capacity becomes less. To illustrate this, consider the following example:

Charging at 2.15 volts per cell, using a charger with 75% capacity as compared to 12.5% of battery's 8-hr rate (charger six times as large) only reduces required charge time about 20 to 30%.

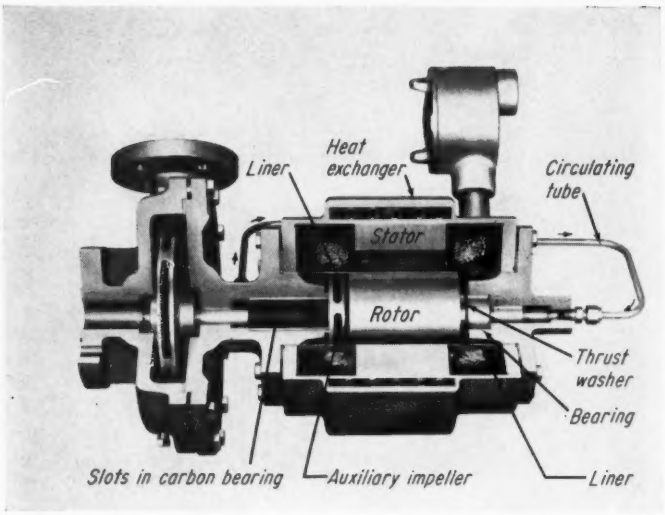
At a higher charge voltage, such as 2.33 volts per cell, increasing charger size from 12.5 to 75% of battery's 8-hr rate reduces charge time about 70 to 80%. It's also a fact that close to 90% of battery capacity will be available (90% discharged amp-hr returned) in a very much shorter time than required for complete recharge.

Next month's article (last of series) will discuss charging lead-calcium batteries, and general temperature considerations for both grid types.

OPERATORS' NOTEBOOK **145**

Canned-rotor pumps find new uses

By STEVE ELONKA, Associate Editor



TO HANDLE HOT FLUIDS, pump has integral heat exchanger, auxiliary impeller and a thermal barrier between pump chamber and motor section

It's a safe bet that you've been hearing more and more about canned-rotor pumps lately. Constructed with no seals or stuffing boxes, these pumps eliminate leakage. For this reason the smaller units shown here are popular for process work, while larger ones are used for large boiler circulators and to circulate radioactive liquids in nuclear plants where leakage spells disaster.

Canned-rotor pumps combine pump and motor into a single leakproof unit. Since there are no shaft-sealing devices, there's no opportunity for volatile fluids, fluids under high pressure or otherwise hard-to-handle to leak out, nor can leakage in under vacuum conditions contaminate sensitive pumpage. Because leakage of radioactive liquids cannot be tolerated, canned pumps have an exclusive on that service. These pumps handle pressures up to 5000 psi and temperatures ranging from the icy cryogenic regions, –280 F and below, to torrid zones around 1000 F.

Design of canned pumps features just one moving part, a combined rotor-impeller assembly driven by the rotating magnetic field of an induction motor. What is unique here?—both rotor and stator are hermetically sealed with corrosion-resistant nonmagnetic-alloy liners to isolate windings, permit pumped fluid to flow through the motor section.

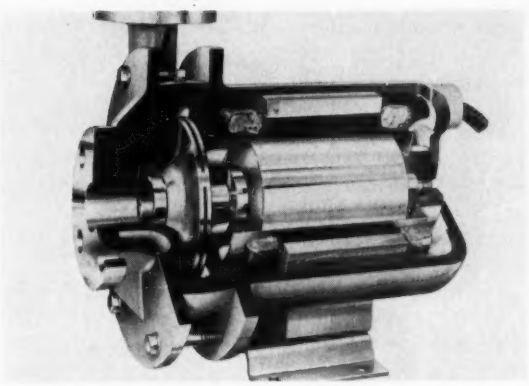
This small portion of main pumpage flows through the circulating tube running from discharge to the rear of the motor section, through the rotor chamber, across the carbon-graphite bearings and back into the main pumped stream. Thus the circulation cools the motor and automatically lubricates the bearings. In high-temperature units the circulating fluid can be cooled with a built-in heat exchanger before doing its work.

Dependable cooling uses a tube connecting high-pressure side of the pump volute to the rear of the rotor chamber. Because of pressure differential between high and low sides of the pump a small amount of the pumpage circulates through the rotor chamber, cooling the inside diameter of the stator, the rotor, and also the pump bearings. Amount of fluid used for this purpose is regulated, averages about ½ of 1% of total fluid handled by the pump. This volume is about the same as recirculated by the wearing rings of a standard pump.

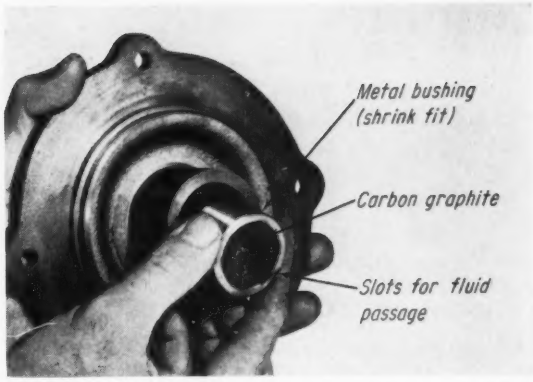
Operating life of bearings and stator windings depends on these conditions: fluid flowing through the bearings and motor should be free from solids. It should stay within certain viscosity and temperature limitations.

Solids can damage rotor and bearings and finally cause motor burnout if the circulating system becomes clogged. For longer life, some canned-pump models are filter-protected. Clean fluid flows through the motor section from the filtrate side of a fine-mesh-screen filter fitted into the discharge neck. This filter, open top and bottom, is constantly washed by the main pumpage stream. Under proper operating conditions canned-pump maintenance boils down to periodic bearing replacement.

Hot-fluid pumpage demands a normal Class-A insulated motor winding rated for 105-C—221 F. Pumps limited to 180-F fluids give plenty of safety margin. For temperatures up to 450 F, Class-H winding is used. But fluids around 600 F must often be handled—Dowtherm and oil heat-transfer agents. A heat exchanger is inserted



FOR WARM OR COOL FLUIDS this canned pump needs no heat exchanger. Gasketless construction with O-ring seals is used here



BEARINGS are made of carbon graphite. There's no lube required—pumpage lubricates by recirculating through slots, right

in the fluid circulating line so these hot fluids can be taken in stride without doing any damage.

Tests indicate that on 600-F pumping jobs, using the heat-exchanger setup, winding temperature won't exceed 350 F. This is well within the limits of Class-H. As we've said, top limits for these pumps are 1000 F and 5000 psi.

Bearing alignment is obtained and maintained by shrinking the bearing material into a bearing sleeve. Assembly is honed on inside diameter and ground on outside diameter to a close tolerance for complete concentricity and alignment.

Rotor is shrunk onto the shaft, then "canned" with stainless steel or some other corrosion-resistant material comparable to the stator liner. This rotor cover is rarely over 0.012-in. thick, for two reasons: (1) rotor replacement forced by corrosion is not as critical as stator replacement (2) air gap of the motor must be kept as small as possible. Welding end plates to the "can" and shaft completes the assembly except for installing thrust washers on either side of the rotor.

Normal clear-fluid pumpage is used just as it is to cool and lubricate the pumps. Slurry or other dirty applications need a system of backflushing. Mother liquor is fed into the rear of the unit to cool and also keep abrasives out of rotor chamber and away from bearings.

Of course, backflushing can be used only with machines designed for the purpose. These pumps have clear fluid piped to the fitting at the rear of the motor section. Amount of clear base fluid introduced in this manner may be 0.6 gpm or as much as 3 gpm. Amount depends on application, fluid properties, pressure differential and size of backflush piping. Pressure of backflush liquid at the fitting must be at least 5 psi but not more than 20 psi above pump's suction pressure.

Unless specially designed, no canned pump should run dry except for the few seconds needed to check direction of rotation. Otherwise parts with close tolerances may heat, expand, gall and seize.

Pumps must be primed—flooded—with clear liquid before pumping action will start. When there is a positive suction head on the pump, priming involves opening the suction valve, venting the pump casing and allowing casing, rotor chamber and circulation piping to fill with fluid. Some designs have a vent in rear of bearing housing and in circulation piping system.

Where suction lift exists, the pump must be primed by other methods. One of these: manually fill pump, rotor chamber and all circulation piping with pumped fluid. Suction at very low pressure or under vacuum may produce a tendency to vapor lock. This result of insufficient npsh will cause erratic, therefore reduced delivery.

Maintenance never involves external lubrication since the bearings "float" in the recirculated liquid. If motor seems hotter than usual or noisy, the circulating tube may be plugged or partially plugged; you should inspect it. Use compressed air to keep it clean. When a backflushing system is used and a screen or filter is included in the auxiliary piping, clean filter at intervals.

Bearings should be inspected not later than three months or 1500 running hours after initial startup. This helps you determine rate of wear and establish a replacement schedule. Always check bearings for equal wear.

Hold down demineralizer regeneration cost

Major operating costs in demineralizer plants occur during regeneration. So a careful check of chemicals, water and time used will pay dividends

By W C BURNS, Project Manager
Cochrane Corporation

Regeneration of a demineralizer by definition is the restoration of an ion-exchange resin's capacity by replacing ions removed from the water treated, with ions initially present in the active resin. Here is where you spend your operating money—for chemicals, raw backwash and rinse water and in some cases a certain amount of partially demineralized water. Here also is where you can save operating money—by proper procedure and careful attention to details.

Demineralizer regeneration takes place when resin's ion-exchange capacity is exhausted or at least spent to a point imparing output quality. Conductivity measurement of effluent, treatment of a predetermined total flow, silica tests or some other method will indicate resin's loss of capacity to further demineralize influent water, showing when that point is reached.

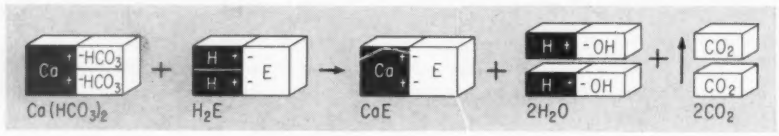
In addition to chemicals required it takes considerable water to backwash and rinse ion-exchange resin. Piping and valves must be designed to carry this water to demineralizer vessels and then to waste, so regeneration flows must be accurately determined for each step in the demineralizer-regeneration cycle.

Regeneration may be manual or fully automatic (see POWER, Feb 1958, pp 74-75). In either case the same basic principles apply for demineralizer regeneration.

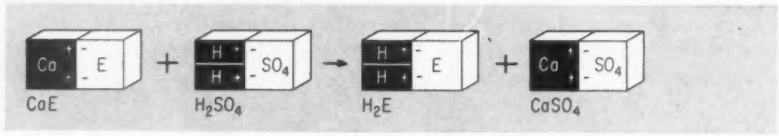
In Nov 1960 POWER, pp 75-77, we designed a hypothetical 2-bed demineralizer plant to treat 216,000 gpd.

Principles of ion exchange: key to regeneration

Throughput



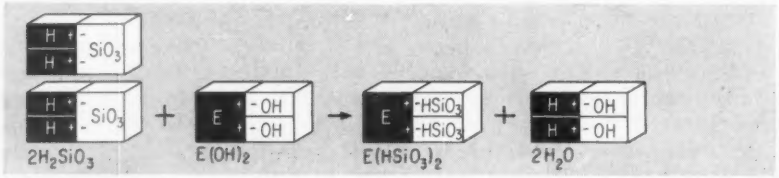
Regeneration



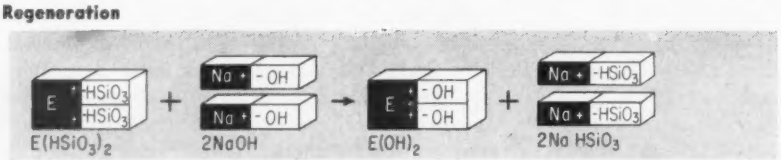
Cation

Hydrogen-cation exchangers swap hydrogen ions for metal cations in the untreated water. Then regeneration with acid restores hydrogen ion's exchange capacity

Throughput



Regeneration



Anion

Strong-base anion exchangers do a good job of removing silica from the feedwater. Regeneration with caustic restores capacity for hydroxide exchange

Both resin vessels were 6½ ft in dia. Cation vessel was 10-ft 3-in. high and contained 183 cu ft of resin; 6-ft 6-in. high anion vessel held 108 cu ft. A decarbonator between cation and anion vessels removed most CO_2, reducing the anion-unit load. We showed, as a matter of fact, that without the decarbonator the anion vessel would have to be 13-ft 5-in. high, containing 220 cu ft of resin.

Let's take this same plant, figure regeneration operation and water needs. Chemical needs were necessarily a part of the design calculations previously carried out.

Cation unit

First we'll regenerate the cation unit completely. Influent water may be used for all operations here because initial run after regeneration will, of course, use normal influent water.

Backwash of cation vessel reclassifies and unpacks the resin and washes foreign matter and resin fines to waste. Backwash rate depends on water temperature, usually runs about 6 gpm per sq ft of resin-bed surface. Our 6½-ft-dia cation vessel's bed area was 33.2 sq ft, so we'll need 199 gpm (6 gpm per sq ft x 33.2 sq ft = 199 gpm). Backwash should continue for about 15 min, so in all we'll need 2985 gal of water (15 min x 199 gpm = 2985 gal) to complete the backwash cycle.

A single pilot-operated control valve usually governs the entire regeneration process. Pilot actuates various separate diaphragm valves inside the single control leading to and from the cation vessel. When pilot valve is turned to "backwash," water enters through underdrain, expands resin bed and goes through normal inlet distributor to waste.

Acid is introduced to actually regenerate each resin bead. Sulfuric acid takes preference over hydrochloric or nitric because of low cost, availability, ease of storing and handling, reduced danger to operating personnel. Acid rejuvenates cation resin as shown at left. But one of the products formed is $CaSO_4$, an insoluble white precipitate which reduces bed efficiency if it's permitted to collect on the resin. To take care of the $CaSO_4$, introduce dilute acid either in progressive batch steps or in a stepless pattern starting at about 2% concentration and ending at 4, 6, or 8%. Be sure to use proper flow rate (0.5 to 1.5 gpm per cu ft of resin), passing acid through the resin bed rapidly enough to prevent precipitation but not so rapidly as to decrease efficiency. If influent water contains very low Ca, acid may of course be introduced in a single step—but this will be rare.

Acid requirement for our cation unit: 915 lb of 100% H_2SO_4 (5 lb per cu ft x 183 cu ft = 915 lb). This equals 66 gal of 66-deg-Bé (93%) acid per regeneration (915 lb x 100/93 x 0.675 gal per lb = 66 gal). Use 2-step regeneration, introducing half the acid at 2% concentration and the remainder at 4%. For a 2% concentration, 2690 gal are required (915 lb x 0.5 x 5.88 gal per lb = 2690 gal). At the rate of 1 gal per cu ft, flow rate is 183 gpm and contact time is 14.7 min (2690 gal/183 gpm = 14.7 min). So you'll need 2.24 gpm of acid feed (33 gal/14.7 min. = 2.24 gpm). Dilution water needed is 2657 gal (2690 gal – 33 gal = 2657 gal) and dilution rate is 180.75 gpm (2657 gal/14.7 min = 180.75 gpm).

Remaining acid is to be introduced at a 4% concentration. Using same methods of calculation you'll come up with a total quantity of 1345 gal of which 33 gal are acid and 1312 dilution water. Contact time is 7.25 min; acid-pumping rate is 4.55 gpm; dilution-water flow rate is still 180.75 gpm. A word of warning: in changing acid concentrations be sure to vary the strong-acid rate, *not the dilution-water rate.* A change in dilution-water rate would cause a 2-to-1 flow-rate variation at the bed, reducing distribution efficiency.

Introduce dilution water for the acid at a constant rate through a rate-setting valve; meter it and mix with the strong acid in a lead-lined mixing tee. An automatic 2-position throttling valve controls the strong acid. To be sure dilution water won't flow back into the strong acid and cause excessive corrosion, check these points in your design:

(1) Design prevents strong-acid pump from starting until dilution flow is established.

(2) Strong-acid-pump discharge pressure builds up to a preset point. Then contact in pressure switch opens two strong-acid valves and closes the bleed valve, allowing acid and dilution water to mix safely.

(3) Steps (1) and (2) reverse when you're closing down acid flow; that is, be sure acid valves close first, then the acid pump can be permitted to stop.

(4) Provide two strong-acid valves in series with a

These are resin characteristics

Characteristic	Cation resin*	Anion resin**
Physical form	hard bead-like particles, shipped moist	
Chemical form (as shipped)	Na^+	Cl^-
Density as shipped, lb per cu ft	53	42 to 46
Moisture, %	44 to 48	53 to 57
Grading, U.S. screen mesh	16 to 50	16 to 50
Uniformity coefficient	2.0 max	1.75 max
pH limits	1 to 14	none
Max temperature, deg	250	140

*Styrene-base cation resins cross-linked with divinyl benzene, with SO_3H — as the active exchange site
**Type I anion resin, porous grade, styrene-base cross-linked divinyl benzene with NH_4 — as the active exchange site

Conductivity shows leakage

Resistance, ohms	Conductivity, micromhos	NaCl leakage, ppm as $CaCO_3$*	NaOH leakage, ppm as $CaCO_3$**
3,000,000	0.33	0.13	0.06
2,500,000	0.40	0.16	0.08
2,000,000	0.50	0.20	0.10
1,000,000	1.00	0.40	0.20
500,000	2.00	0.80	0.40
100,000	10.00	4.00	2.00
50,000	20.00	8.00	4.00

*Applies to mixed-bed or 2-bed weakly basic anion electrolyte
**Applies to 2-bed strongly basic anion electrolyte

To cut costs, measure wash and rinse water, use right amount only

bleeder line between them ahead of the mixing tee. Bleeder line acts as a telltale, carries any leakage to waste, preventing strong-acid leakage into the dilution-water system and vice versa.

Displace acid by shutting off the strong-acid supply but leave the dilution-water line open. Most strong acid will be displaced and the piping will be purged. Total volume required is about half the resin-bed volume; in our case 686 gal (183 cu ft x 0.5 x 7.5 gal per cu ft = 686 gal). Rate is 180.75 gpm, same as dilution rate, and time about 4 min. Operation follows acid-introduction procedure except, of course, acid flow is stopped.

Final rinse removes all traces of regenerant in the resin bed. Flow should be about 6 gpm per sq ft. When the free mineral acidity of the rinse is about twice the expected service-run fma, stop the rinse. This should occur after a total flow of about 50 gal per cu ft of resin.

Total water required for rinse is 9150 gal (50 gal per cu ft x 183 cu ft = 9150 gal). Rate is 199 gpm (6 gpm per sq ft x 33.2 sq ft = 199 gpm) and time for final rinse 46 min (9150 gal / 199 gpm = 46 min).

For final rinse, pilot valve opens raw-water valve to top of vessel, permitting flow through distributor, down through resin bed and out the underdrain. Usual practice automatically controls rate by orifice and regulator.

Anion unit

Many operations in regenerating the anion unit duplicate steps we've discussed for the cation unit. But for best results be sure to use demineralized or at least cation-treated water.

Backwash operation for the anion unit is the same as for the cation unit, but you must limit rate to about 3 gpm per sq ft, depending on temperature, to keep from losing less-dense anion resin to waste. Lower backwash rate is not sufficient to remove dirt from the anion bed, so anion influent must always be clean and clear. A 15-min backwash usually suffices, so rate for our design is 100 gpm (33.2 sq ft x 3 gpm per sq ft = 100 gpm), total flow 1500 gal (100 gpm x 15 min = 1500 gal).

Introduce caustic to regenerate anion-resin beads. Sodium hydroxide is the universal regenerant, but it must be highest-quality mercury cell (rayon grade) or equal or it will foul the expensive anion resin. Caustic strength at bed should be about 4%, temperature about 120 deg for best silica removal. Check following caustic rates for best results:

SiO_2 of TEA, %	*Contact time, min*
5	60 minimum
10	75
20	90 maximum

If flow rate you work out from this table is less than 0.25 gpm per cu ft of resin, use 60 min as minimum contact time.

Our design has 4.6% silica, so use 60-min total contact time. You'll need 432 lb of caustic at 100% concentration (4 lb per cu ft x 108 cu ft = 432 lb. Usually, however, caustic comes as 50% liquid; in this case you'll need 68.6 gal (432 lb / 6.3 lb per gal = 68.6 gal) of the solution.

Caustic pump rate is 1.1 gpm (68.6 gal / 60 min = 1.14 gpm) and total flow is 1271 gal of 4% caustic at the bed (432 lb / 0.34 lb per gal = 1271 gal).

The 4% caustic is pumped in at 21.2 gpm (1271 gal / 60 min = 21.2 gpm). Dilution water needed: 20.06 gpm (21.2 gpm – 1.14 gpm = 20.06 gpm) or a total of 1203 gal (20.06 gpm x 60 min = 1203 gal).

Operation follows cation regeneration except that dilution water should be heated in a closed heater to maintain about 120-F temperature in the dilute regenerant.

Displacement is exactly the same as cation-unit displacement. You'll need 405 gal (0.5 x 108 cu ft x 7.5 gal per cu ft = 405 gal) and rate will be 20.06 gpm (same as caustic dilution rate). Time is 20 min (405 gal / 20.06 gpm = 20 min).

Final rinse to remove all caustic remaining in the resin bed is generally 5 to 6 gpm per sq ft; about 80 gal per cu ft of resin is recommended. But rinse-water requirement may increase with resin age because of self-degradation. Stop the rinse when conductivity reaches a figure about twice what you expect in the average service run.

End point of rinse for our design is at 4 ppm (20 micromhos). Volume needed is 8640 gal (108 cu ft x 80 gal per cu ft = 8640 gal) and rate is 199 gpm (6 gpm per sq ft x 33.2 sq ft = 199 gpm). Rinse time: 43 min (8640 gal / 199 gpm = 43 min).

Rinse recycle is often used in medium and large plants to save water and cation capacity. Here final rinse water is diverted from waste to inlet header of the cation when rinse-water conductivity equals that of the raw water. Water thus recovered is recycled, not wasted. This additional step in the anion-regeneration cycle often saves about half of the total rinse water.

A summation of time and water needed to regenerate our hypothetical demineralizer unit:

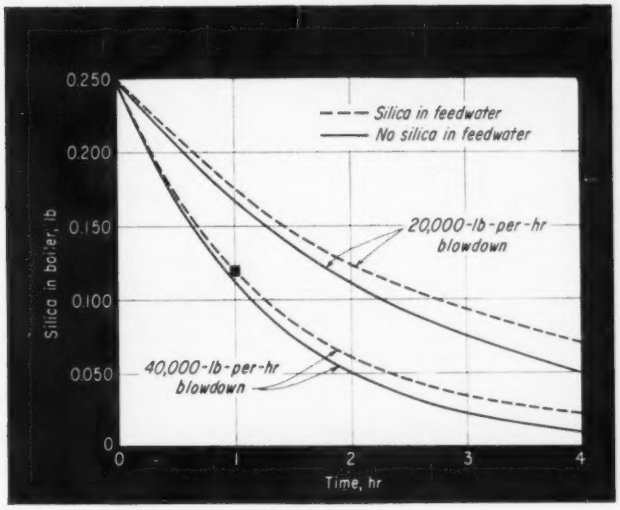
Unit	*Water, gal*	*Time, min*
Cation	16,856	87
Anion	11,816	138
Total	28,672	225

But operating sequences can be telescoped so cation unit can be fully regenerated while anion unit receives its caustic soda and displacement. Then total time drops from 225 to 138 min.

By VIRGIL I JOHNSON,
Oklahoma Gas and Electric Company

How much silica in your boiler?

To find best blowdown procedure to control silica in your boiler, you must know how much silica is actually there at any given time



AMOUNT OF SILICA IN THE BOILER can be determined at any given time from blowdown rate and silica content of the feedwater

Especially during startup, it is a good idea to keep track of your boiler's silica content. It helps to set blowdown rate effectively and can aid in avoiding reduced-pressure operation during this critical period. Of course silica content can be determined by sampling boiler-drum water and testing it, but there is another way too —by calculation.

At our Riverbank Generating Station, we have come up with a rather neat way to do this. Don't let the calculus frighten you off; it's really quite simple. Curve, above, shows the results and gives various silica contents vs time for two blowdown rates both with and without silica in the feedwater. This is for one particular boiler and feed cycle, but you can make up such a curve for yours too.

A quick look at the curve shows that where no silica is being added to the boiler and equal amounts of blowdown are considered, blowdown rate times time is a constant. And if feedwater contains silica, silica reduction is greater using the increased rate for half the time. For example, when there is no silica in the feedwater, a blowdown rate of 20,000 lb per hr for 1 hr gives the same silica reduction as a rate of 40,000 lb per hr for ½ hr. If there is silica in the feedwater, a blowdown rate of 40,000 lb per hr for ½ hr gives a greater reduction in boiler silica content than 20,000-lb-per-hr blowdown for 1 hr.

Now let's look at the calculation needed to construct a similar curve of your own. Some unknowns may enter the problem, so be sure to interpret your curve with allowance for them. Let's run through the calculation assuming these typical conditions:

(1) Drum capacity to firing level—50,000 lb
(2) Drum level remains constant
(3) Drum contains 5-ppm silica (0.25 lb)
(4) Silica in feedwater—0.01 ppm (in plotting other curves, silica in feedwater was zero)
(5) Silica in steam—zero

Q = lb silica in boiler at time t. So dQ/dt is the rate of silica gain or loss. Silica in the feedwater is 0.01 ppm; silica in the boiler is decreasing in our case. So ΔQ is negative. Feedwater flow must equal sum of steam flow and blowdown—one million lb per hr in our case (960,000-lb-per-hr steam + 40,000-lb-per-hr blowdown).

$$\text{Rate of gain} = \frac{0.01}{60} = 0.0001667 \text{ lb per min}$$

$$\text{Rate of loss} = \frac{Q \times 40{,}000}{50{,}000 \times 60} = \frac{Q}{75} \text{ lb per min}$$

$$\frac{dQ}{dt} = 0.0001667 - \frac{Q}{75} = \frac{0.0125 - Q}{75}$$

$$\frac{dQ}{Q - 0.0125} = -\frac{dt}{75}$$

Now integrate both sides between limits shown:

$$\int_{0.25}^{Q_{60}} \frac{dQ}{Q - 0.0125} = -\frac{1}{75}\int_{0}^{60} dt$$

$$\log_e (Q_{60} - 0.0125) - \log_e (0.25 - 0.0125) = -1/75\,(60 - 0)$$

$$\log_e \frac{Q_{60} - 0.0125}{0.25 - 0.0125} = -0.8$$

$$\frac{Q_{60} - 0.0125}{0.2375} = e^{-0.8}$$

$$Q_{60} = 0.0125 + \frac{0.2375}{2.2255} = 0.1191 \text{ lb}$$

You can repeat this calculation for several blowdown rates and times to show best procedure for your particular operation.

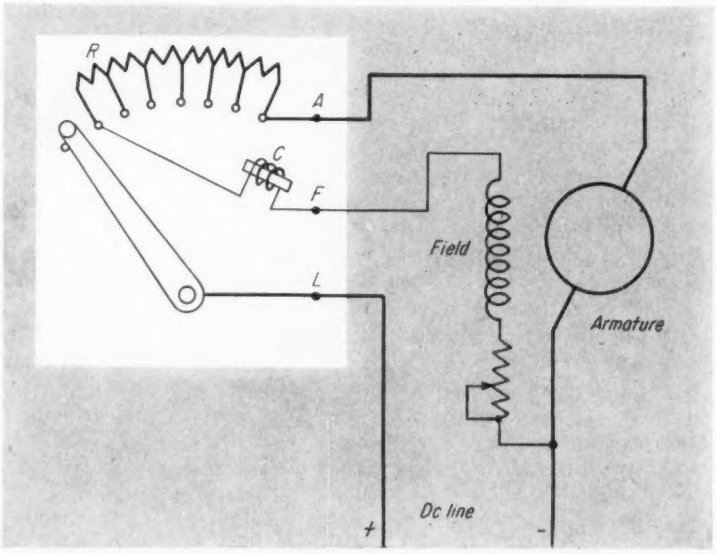
Plant Electrical Fact File

NO. 54: STARTING DC MOTORS

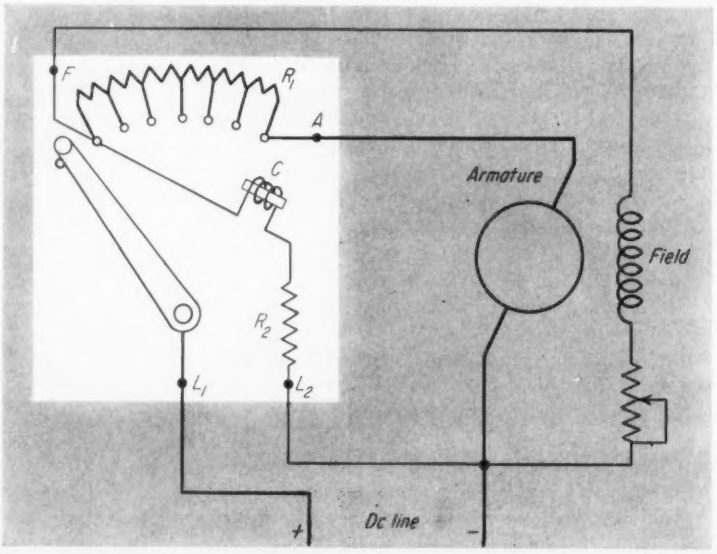
5 ways to start dc motors

Direct-current motors have reestablished themselves in today's plants because they give excellent service on adjustable-speed applications. But unlike ac motors, dc units can't be started directly across line, except smallest fractionals. Armature voltage must be reduced to prevent excessive current until armature comes up to speed, limiting current by counter emf. Armature starting control may be incorporated into adjustable-speed control as in schemes *4* and *5*.

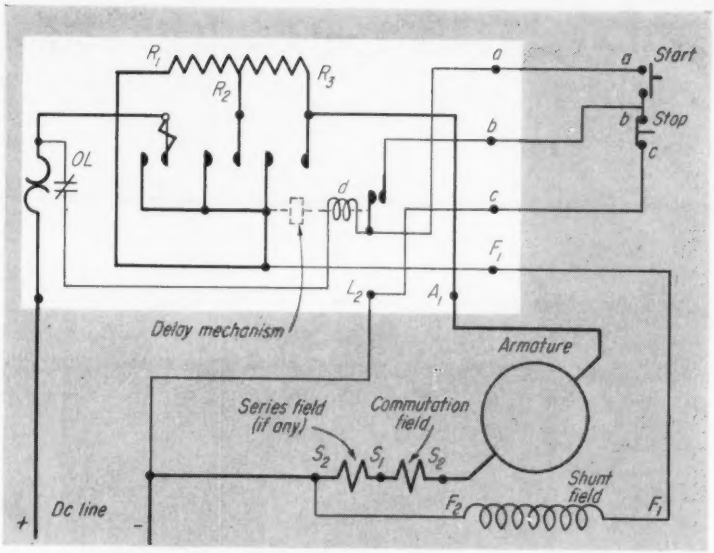
By NORMAN PEACH, Associate Editor



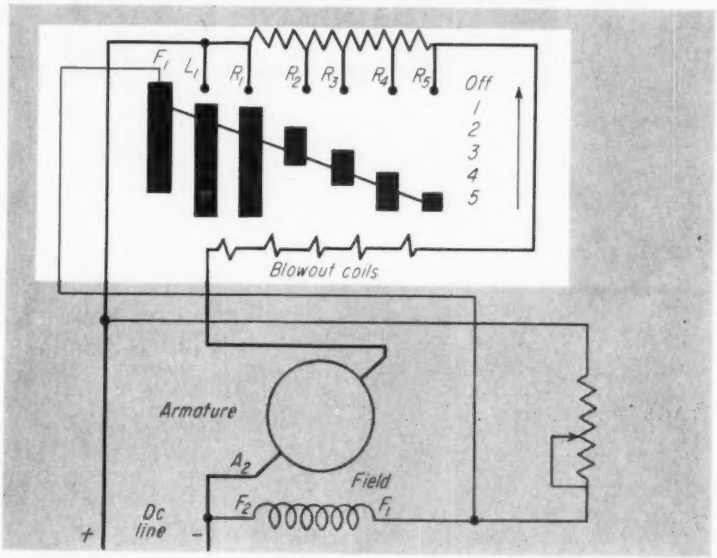
1 **3-POINT MANUAL** starter is simplest type for shunt motors where small speed adjustment you get by varying field strength is satisfactory. Holding coil *C* is in series with field, so reducing field current too far causes control arm to drop out of running position and shut down motor. This is advantageous should field circuit accidentally open with a light load — otherwise motor overspeeds and might damage itself or machine



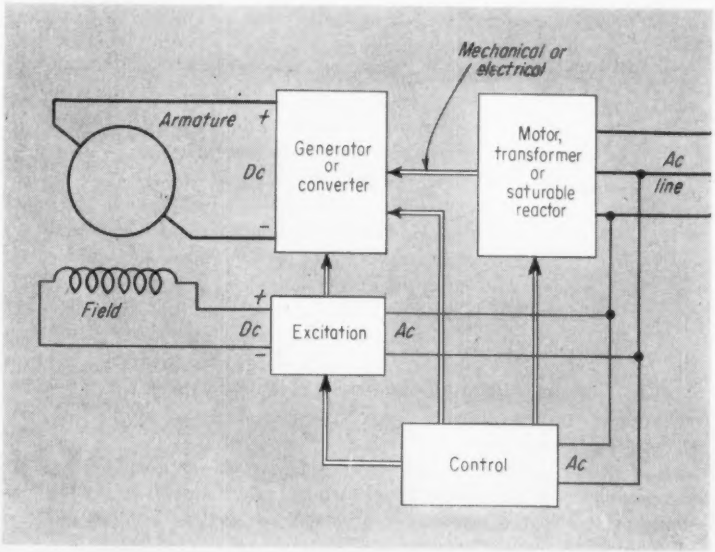
2 **4-POINT MANUAL** starter differs from 3-point only in manner of holding control arm in running position. Both types provide undervoltage protection but 4-point starter doesn't give field-failure protection. It does, however, permit a wider speed adjustment by field control. Holding coil is in series with its voltage-dropping resistor R_2 and starting rheostat R_1



3 **AUTOMATIC STARTER** is actuated by pushbutton which closes circuit from negative line through L_2, c, b and the solenoid d. This closes start contact e which connects field directly across line and connects armature through R_2 and R_3. Accelerating contacts f and g close successively, shorting out R_2 and R_3 and finally putting armature directly across the line. Pushing stop button opens c, deenergizing coil d and disconnecting motor



4 **DRUM CONTROLLER** can be used for starting and speed adjustment by armature control. It's suitable for series and shunt motors (and compound, though they're not generally recommended for adjustment-speed service). With shunt motor, drum controller can be used in conjunction with field rheostat for combined armature-field speed control. Drum controllers are especially suited to rugged service, such as cranes and hoists



5 **ARMATURE-VOLTAGE CONTROL** by means other than series resistance is basis of modern adjustable-speed drives. Motor-generator sets, saturable reactor-rectifier combinations and ignitrons or thyratrons may be employed in variety of schemes. These circuits achieve much better speed control and generally lower losses. Reduced-voltage starting is natural

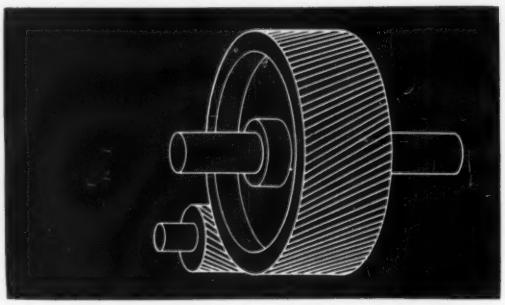
These **plant problems** could well be yours...

Problem... What causes gear noise?

About 18 months ago our two 525-kw turbogenerators were completely dismantled for survey. These units had been satisfactory prior to survey, but have operated ever since with a near-intolerable noise. This noise is very high-pitched and seemingly originates in the reduction gears.

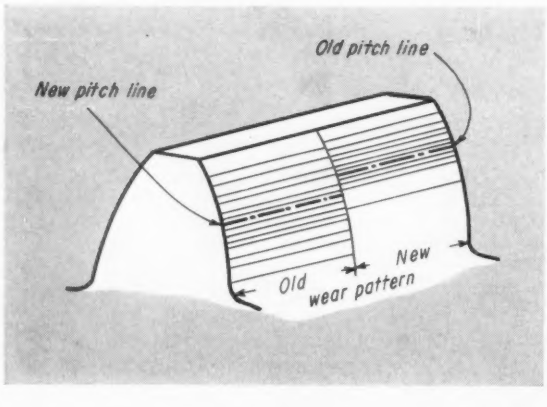
Repeated inspections of gears reveal no excessive wear and good contact throughout. Thrust and journal clearances have been shifted through full range of tolerances. Bearings have been renewed. Manufacturer's rep has made personal inspection and found no misalignment. There is no apparent excessive vibration to indicate unbalance.

Reduction is 5645/1200 single helical. Pinion is 5.41in. pitch diameter, gear is 25.5 in. There are 44 and 207 teeth respectively. Width of face: 8¼ in. The driven members of each unit consist of one 400-kw alternator, one 75-kw exciter and one 55-kw exciter.



Other than this ear-piercing noise we have had no operational difficulties. This unpleasantness is not diminishing with time, however, and we are almost desperate. Do you believe any of your readers could extend a saving hand?—*HLH, September* POWER

Solutions...



Check new wear pattern on gears

After *HLH*'s gears were in service for some time and before shutdown, wear of the journals and supporting bearings increased center distance and pitch diameter. Until the survey, gearing was quiet because one of the desirable characteristics of involute gearing is to run quietly even with reasonable increases in center distance. This kind of operation is not desirable from a wear standpoint, but the gears *are* quiet so trouble usually goes unnoticed.

Gear tooth, left, illustrates wear patterns somewhat exaggerated. Stripes adjacent to pitch line indicate rolling- and sliding-contact areas. Sliding contact predominates at begining and end of mesh while pure rolling occurs at the pitch line. Therefore, with no wear at the pitch line we should expect curvature of the teeth to change as we move away from the pitch line.

Installation of new bearings gives normal pitch-line contact again and the inclination to roll and slide shown at left. Comparing the two wear patterns on the same tooth gives us a better picture of the situation. Here we can see how the infinitesimally small and not worn area around the old pitch line will now act as a hump in a different location of the new wear pattern. In addition to this hump, the new wear pattern imposed on the changed curvature and surface irregularities of the old pattern will mismatch the gears and cause the near-intolerable noise at high pitch-line velocities.

Best solution: obtain a new set of gears and replace the bearings more often to take care of the displaced journal centers. Otherwise, *HLH* will have to live with the noise.

E WITTMANN, *Villas, N.J.*

...Here's how Power readers would tackle them

L E STEWART, Associate Editor

Look to your lubricating system

In any gear box there are four principal components: (1) the gears themselves (2) thrust bearing to control axial position (3) journal bearings to control radial position (4) the lubricating system.

According to the information *HLH* has given, the first three components can be discarded as possible causes of the noise, leaving the lubricating system as the culprit. Quite often some very minor and unimportant change in lubrication will cause this phenomenon.

If I were *HLH*, I would ask myself these questions:

(1) Has there been any change in height of the oil sump since the time of the survey?

(2) Am I using the same viscosity oil I used prior to the survey?

(3) Have I increased or decreased my oil pressure above or below the pressure used before the survey?

(4) Have I cleaned my oil-vent filter since the survey?

(5) Have there been any changes made in the positions of my oil nozzles since the survey?

(6) Is there any plugging in my oil lines or nozzles, or were my oil-nozzle orifices damaged in any way during the survey?

(7) Has there been an increase in the diameter of the oil-nozzle orifices caused by erosion?

Many very sound engineers fail to realize that a lubricant not only provides a slipping area and removes heat, but acts as a noise dampener as well.

J L DOWNING, *Brooklyn, N.Y.*

Recheck oil level

HLH states his noise problem occurred after the gears were inspected. Although he does not mention it, I assume the oil was drained out of the housing at that time and after inspection was completed he flushed and replaced with fresh lubricant.

Oil pocketing may occur if too much lubricant is used. Since oil is nearly incompressible, a meshing gear tooth with a pocket will cause a large shock.

Minimum oil volume causing pocketing may be estimated from the following relation:

$$V = C \times U \times F/231$$

where C = gear clearance, in., U = pitch-line velocity, in. per min, F = gear-face width, in.

Surfaces of gear teeth have peaks and valleys with lubricant filling the latter. After a period of operation the peaks are worn down, causing a thin oil film to cover the surfaces. Resulting friction produces heat and noise.

Extreme-pressure (EP) lubricants with additives are frequently used for this type of service. They form a chemical combination on the metal surfaces which improves lubrication and reduces noise generation possibilities.

Usually, gear housing has a level indicator and thermometer which lets you check that required oil quantity and temperature are maintained. Observed values should be compared with those recommended by the manufacturer.

Insufficient lubrication of shaft bearings or variable oil pressure causes radial motion of gears. This is because the oil film produces unbalance of gear radial and other forces.

Although *HLH* states inspection indicates little wear and good contact, I suggest the following procedures to overcome the noise problem:

(1) Test lubricant and compare its physical properties with those recommended by the gear manufacturer. Viscosity, temperature and cleanliness are important.

(2) Measure dimensions of gear teeth and compare with design values. Tip and root relief may improve contact.

(3) Check backlash.

(4) Test gears and pinions for static and dynamic balance. Unbalance tracing to unequal wear will cause variable tooth pressure.

H B WAYNE, *Woodhaven, N.Y.*

Were tolerances set on cold unit?

I believe the first problem to be solved by *HLH* is definitely isolating the piece of equipment causing the noise. He should uncouple turbine from reduction gear, reduction gear from alternator, alternator from exciter, etc. He can then start the turbine and check it out. As each piece of equipment is checked out it should be recoupled and the procedure repeated for each component until the faulty unit shows itself through a higher noise level.

If the trouble turns out to be the reduction gear the answer must be (1) badly worn gears (2) worn bearings, letting shaft drop enough to give incorrect gear mesh or (3) making all tolerance settings while the unit is cold.

HLH seems to rule out the first two possibilities, but I wonder about (3). If settings are made on a cold unit without proper allowance for expansion this could change all settings enough to cause the trouble. If at all possible, all clearance settings should be made with the unit at or near its operating temperature. I feel that the solution must be something of this nature as it seems odd that two units that were satisfactory before an overhaul should suddenly develop the same trouble following the overhaul.

R J NEIERT, *Cincinnati, Ohio*

Want some help on plant problems? Send us any of your design or operating headaches for *Power* reader comment

Problem . . .

How can we repair our reservoir?

We have a 100,000-gal decked reservoir which we must renovate. We would like readers to tell us how best to gage metal thickness of reservoir plates without spending a lot of money for equipment.

Once mechanical repairs are completed we wish to scour interior to a bright metal finish and apply any one of a number of coatings—probably bitumastic stock since it won't taint water in beer casks.

Our water comes from mountain sources at 54 F.

Finally, should we worry about the explosive nature of the light tails driven off in the spraying process? Do we need air supplied to respirators for men working on coating?—*RDE, September* POWER

Solutions . . .

Try phenolic coatings

Several types of instruments for determining thickness of steel plate are available. These units are portable, employing an electric current for measurement. An emf is impressed across a circuit comprising the plate, a variable resistance and a wheatstone bridge. Varying plate thickness causes a proportionate voltage drop, resulting in current change. A scale calibrated to express resistance in terms of material thickness gives a direct reading.

These instruments may be purchased or rented. Or several companies offer this service at nominal cost—latter include commercial testing laboratories and industrial insurance companies. Since *RDE* probably will not have further need for this facility, I suggest he have a nondestructive test made by a company offering this service.

Use of bitumastic is not recommended because of the high cost of application. Usually two coats are necessary, requiring much labor and time. For new tanks, general practice is to spray the prime coat in the fabricator's shop and brush a second coat after erection.

For a structure already erected, I suggest a zinc-dust zinc-oxide phenolic coating. This paint is available from several companies; it's similar to Federal Specification Mil-F-15145.

Although red-lead linseed-oil paint complying with AWWA specs has been around for many years, zinc-dust zinc-oxide phenolic paints now are being used more often. At the present time the AWWA is preparing a specification for this material.

Physical and chemical properties vary slightly with different manufacturers. Approximate values:

Film thickness per coat	1.5-2.0 mils
Coverage	900 sq ft per gal
Weight	20 lb per gal
Method of application	Brush or spray

Occurrence of a fire or explosion during application is not probable. Keeping vents, manheads and other connections open during painting aids ventilation. Portable blowers help air circulation. These may be rented at little cost.

H B WAYNE, *Woodhaven, N.Y.*

Let experts test plate thickness

I worked in a boiler plant and saw a similar question arise in connection with a steel coal bunker. Our problem was also what metal needed replacing and what or how much was still sound. Rather than invest money in testing equipment that might never be used again, we called in a testing concern. They brought in equipment that electronically measured the plate thickness. This saved a lot

of time for us because if we had had to drill test holes it would no doubt have taken two or three times longer just to test the plates. The company was very happy with the results and the bunker when repaired was as good as new. *RDE* should probably test his reservoir the same way.

As far as the safety factor is concerned for workmen, "if in doubt, play safe." If the area is well ventilated, he could use only explosionproof equipment, make it a no-smoking area while work is in progress and probably be safe. It is possible that a combustible or explosive mixture could build up in areas of poor ventilation so he should use only explosionproof lights, etc. If the area is poorly ventilated and fans can't be used, use respirators.

R J NEIERT, *Cincinnati, Ohio*

How about sprayed-metal treatment?

Perhaps *RDE* has a budget permitting metal-spray techniques. Metal spray requires no more expensive base preparation than that for bitumastic or hot applications. Initially, surface rust is scraped off with a square-end shovel, then surface is left to dry and either sand blasted or cleaned to bright metal.

For spraying, wire metal feeds to a gun which lays on a smooth coat, replacing metal lost to corrosion. While any of the common protective metals can be used, we found that zinc served our purpose best. Cadmium is second best. Either requires supplied air or canister type of protective breathing apparatus.—W ANDERSON, *Oak Ridge, Tenn.*

Editor's corner

What is your troubleshooting IQ? In POWER's November 1960 issue we ran answers to a problem of apparent turbine hunting. As any operating engineer will tell you, troubleshooting at long distance is rough if not impossible. However, we take our hat off to M L Meyers for spotting the trouble area. His suggestion that hunting was not the fault of the turbine but the result of faulty heater control rang the bell.

To set some readers straight, this was no ordinary plant problem, but a classic case of control feedback we deliberately threw in to give readers something to chew on. The original problem was related to us by the man who solved it, a service engineer for the Steam Turbine Division of Worthington Corporation, and is typical of the many cases where major equipment manufacturers must solve customers' operating problems even though they are far removed from the equipment furnished.

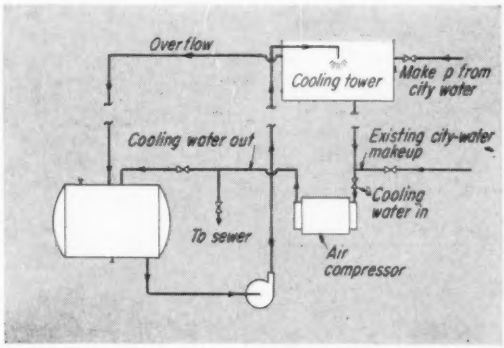
We would like to apologize to Worthington for the turbine photograph accompanying the problem. Selected from our files, it was illustrative only and was *not* the unit in question.

Your January problems

Can we cut pump capacity?

We have been using a positive-displacement (piston type) proportioning pump to inject a fuel additive into the fuel-oil service-pump discharge line. Recently we switched to another brand of additive which requires less quantity but gives better results. This brought up a problem. Our proportioning pump's volumetric capacity can be altered by changing stroke, but after adjusting to absolute minimum delivery we are still using a half gal more additive than we need per 24-hr period.

We feel that some sort of bypass back to the proportioning pump's suction is the answer, but we are not sure how to control amount of additive bypassed to guarantee desired delivery to the fuel-oil stream. Perhaps some POWER readers have solved a similar problem. If so, we'd like to hear from them.—*RAE*



What is our best cooling-water system?

We are considering installing a cooling tower and gravity system to supply cooling water to our 14x13-ft compressor. Suggested system appears above.

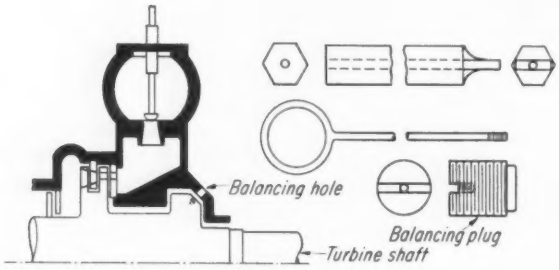
Our present system uses water from city mains at 14 psi and discharges to the sewer at a rate of 600 gph. Cooling load is approximately 4800 Btu per hr.

Would a system as drawn above be economically feasible? Can POWER readers suggest a better means?

—*HEG*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches

Timely **practical ideas** to help solve



At last—a safe balancing-plug tool

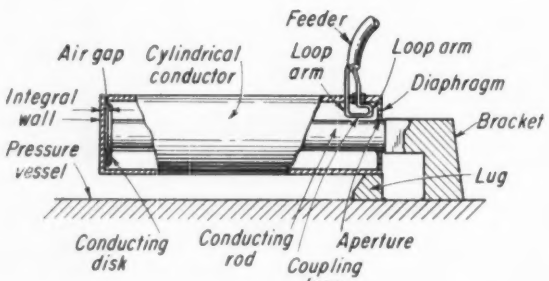
Sketches show the safety tool we use while balancing our turbine-generators. It's risky work removing or inserting balancing plugs in a hot turbine. And dropping one plug usually means dismantling the whole unit.

We built our tool from an old jack drill with a ¼-in. hole through its center. One end is shaped like a screwdriver to fit the slots in the balance plugs. We threaded the ¼-in. rod on one end, added a loop on the other. Plugs were all drilled and tapped for ¼ in.

To use the tool for removing weights, slip the ¼-in. rod into the screwdriver, then insert screwdriver in balance-hole opening in turbine casing and on into balance-plug slot. Screw rod into plug before loosening the plug. With rod in place, use wrench on screwdriver to remove plug—keep plug tight against screwdriver by pulling on rod's loop.

To insert plugs, slip rod into screwdriver, screw plug onto rod and then pull plug into screwdriver slot. Don't remove rod until the plug is screwed tightly into turbine. We use an 18-in. screwdriver, but any length suiting the job is OK. Of course the ¼-in.-dia rod will have to be a couple of inches longer than the screwdriver.

F J HERZINS, *Rosemont, Pa.*



United Kingdom develops atomic-reactor strain gage

Certain areas of the pressure vessels of United Kingdom Atomic Energy Authority's reactors are subjected to high stresses at **high temperatures.** These important areas are normally inaccessible, located inside a 7- or 8-ft-thick concrete biological shield, and working temperatures are high! So ordinary strain gages or extensometers are completely inadequate here.

To solve this problem, one of AEA's electrical engineers at Risley has invented an extensometer for pressure-vessel testing, with good temperature stability and wide range. It's sensitive and remote reading.

Device, sketch, consists of a bracket welded to the pressure vessel carrying a solid conducting rod parallel to vessel's surface. Close to the bracket a lug is also welded to the pressure vessel. It carries a hollow cylindrical conductor parallel to the vessel and surrounding the rod. One end of the hollow cylinder is closed by an integral wall, the other by a diaphragm with an aperture through which the conductor rod passes and in which it is brazed. End of the rod carries a conducting disk spaced slightly from the cylinder endwall to provide an air gap.

A coupling loop from a feeder lies between the conducting rod and cylinder. One arm of the loop contacts the cylinder wall and the other is insulated from it. A variable-frequency oscillator connects to the feeder.

Variation of the vessel's surface strain changes the capacity of the condenser, since its plates are formed by the endwall of the cylinder and the disk on the rod. Oscillator measures change of characteristics shown as a change of wave length. For high sensitivity the electrical length should not exceed ⅛ of the wave length; for operating frequencies of 150 megacycles per second a length of 15 centimeters will be all right.

This device also includes a simple transmitting circuit which works where temperature is not excessive and strain has to be measured in an inaccessible component. Applications include components buried in the ground, embedded in thick concrete or sunk in deep water.—*Courtesy, U.K. Atomic Energy Authority*

Want a "free" book?

Send me a letter describing the latest *practical idea* you've dreamed up to solve a specific problem in your plant. On a separate sheet make a sketch so readers can follow your idea. If we accept the idea, chances are the check you receive will pay for that book you've been wanting to buy.

STEVE ELONKA

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

Single- or double-row ball bearings?

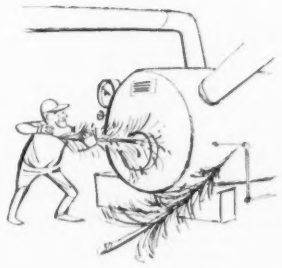
Some pump manufacturers don't use double-row ball bearings for pumps. They claim lubricating these bearings is too big a problem. Based on costly experience, they rule out both oil-ring-supplied lubrication and greasing. A third method — flooding the bearing with oil—seems to work out very well, but for practical purposes isn't often the easiest thing to do.

On these double-row ball bearings, grease must be injected into a cavity on both sides of the bearing so the bearing runs packed. But this can cause trouble; overgreasing always ends up with the bearings running too warm.

Lubricating the bearing with a rotating oil ring does cause a mist of oil to be thrown against the balls and races. But only the first row of balls, closest to the oil ring, get enough oil. The second row receives almost no oil so it starves; the bearings fail.

One set of double-row bearings did last three hours when lubricated with an oil mist from an oil ring. This was under test conditions in the laboratory. Bearings of the same type worked very well when tested with flood-oil system, again indicating that flooding is the only sure method.

There seems to be a lot of misunderstanding about double-row bearings used in combination for radial and thrust loads. Because these bearings are of the maximum-capacity type, each row of balls takes thrust in one direction only. Trouble is, when thrust is in one direction the balls tend to run slightly out of their race path in one race. That causes them to skid slightly. It's this skidding, coupled with lube problems mentioned before, that brings on premature failure.—*Adapted from "The Operator's Corner,"* Goulds News



What would you have done?

A few years ago, lighting off a pulverized-coal-fired boiler was quite a procedure. With the f-d and i-d fans in operation putting out minimum air flow, and with not too long a furnace draft, a fat kerosene-soaked hand swab was shoved into each burner port where it was to do the most good. If the swab wasn't at the right spot, or if there wasn't enough flame, ignition would be delayed. Then the pulverized coal ignited with a roar that blew flame back 20 ft from the open burner ports. Immediate draft compensation, trimming back the coal feed to a minimum stable fire and the unit was well on the way to being in service.

One cold January morning I dropped in on an old shipmate who had taken over a modern pulverized-coal-fired industrial unit. He was faced with the problem of lighting off with no oil available. Plant had been shut down and there was an oil truckers' strike.

I wondered if baffles and casing of his modern boiler could stand the vigorous abuse of old-fashioned lightoff. Then I remembered seeing several small discarded Christmas trees blowing around in the wind outside.

The trees were brought in at my request. I quickly inserted the stem of each tree into the oil-gun support tube of one of the two horizontal burners from the furnace side. The oil guns were in their retracted position. Following the old-fashioned procedure, we lit off the unit as smoothly as we could have with oil.

We all know how violently dried-out Christmas trees burn. Secret of my success was timing in lighting the trees. I used the two small hand swabs provided for normal ignition of oil torches. And timely arrival of the powdered coal helped. What would *you* have done?

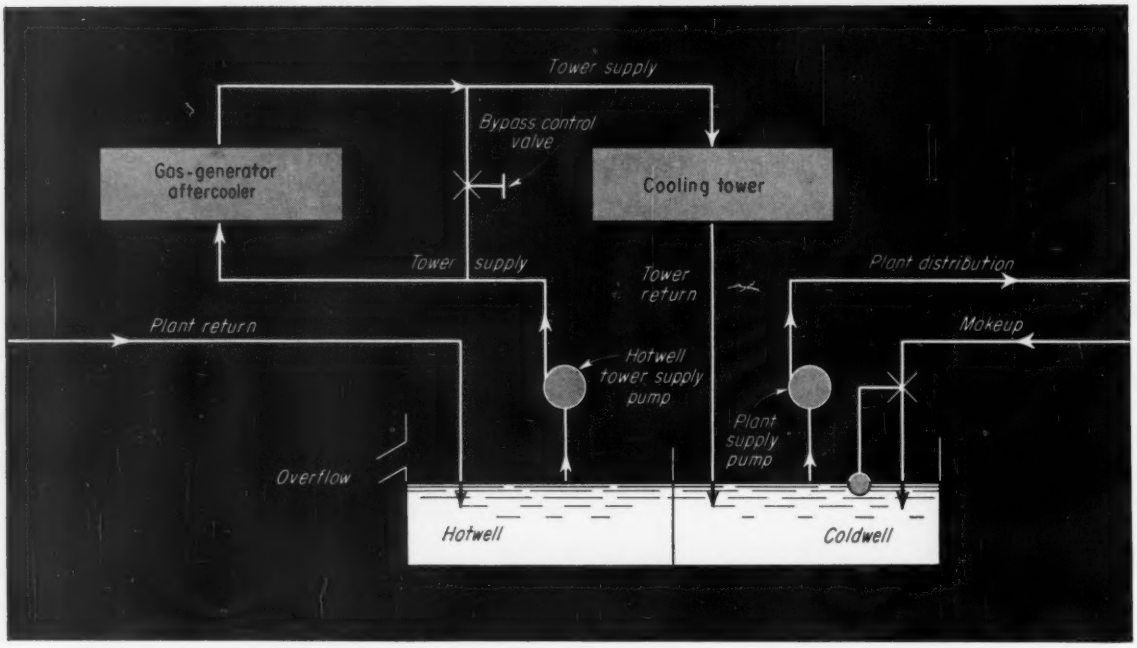
H Moore, Trumansburg, N. Y.

Use a nut to restore threads

We often have to shorten a small bolt. To restore the threads when right-size die isn't available, we leave the nut on the bolt until bolt is cut. Threads are thus restored when the nut is turned off.

You can make a nut specially for this purpose by fluting or filing its grooves so it acts as a die. Threads inside a nut can also be repaired by fluting the bolt and using it as a tap. In emergencies we have repaired the female threads by this method when we didn't have the right size tap or die.

M L MONSON, *Fosston, Minn.*



MODEST CHANGE in plant piping cuts costs by taking full advantage of unused cooling-tower capacity

Conserving utilities can mean big savings. This scheme allowed a plant to . . .

Cut water cost by $25,000

By A M BEEBEE JR, Plant Engineer, Rochester Prod Div, General Motors Corp

We generate inert atmospheres for our metalworking furnaces by both exothermic and endothermic processes. Gas from the former contains water vapor, an oxidizing agent that does metal-treating processes no good. Generally, vapor is reduced by depressing gas mixture's dew point using a shell-and-tube heat exchanger. We were buying about 100-million gal of 70-F water per year for this dew-point control. Even at 70 F enough water vapor remained so we had to overcome oxidizing characteristics by adding richer endothermic gas. This gas is less productive volume for volume, and, since heat must be added to complete its generation, it costs about three times more to produce. Thus if we could use reclaimed water for cooling—releasing heat at the tower—and remove more water vapor, we would save both in water purchase and expensive endothermic gas. Truly a goal to work toward—but with several obstacles in the way.

Applying reclaimed water in the exchanger for dew-point control and releasing heat in our cooling towers dictated an even higher dew point since the temperature limit was 85 F. Too, because the major part of our tower system was being used for hydraulic-oil cooling, water returning from the oil coolers didn't exceed 95 F. Since our towers were designed for an inlet temperature of 115 F, this meant that much tower capacity was stagnating.

We solved the dilemma by designing and installing a direct-expansion aftercooler to take the furnace atmosphere gas as it left the shell-and-tube exchanger. Gas went from 2000 to 120 F in the exchanger, then to 40 F in the aftercooler. With this dew point we reclaim enough water to eliminate expensive endo-gas use.

We wanted to avoid added pumping capacity so we revamped our piping. We used hotwell tower-supply pumps to push water through the gas-generator aftercooler, raising temperature from 95 F leaving the oil coolers to 115 F to take up the tower's full capacity. Our scheme sharply reduced amount of endothermic gas we need and is saving 100-million gal, or about $25,000 in water costs per year.

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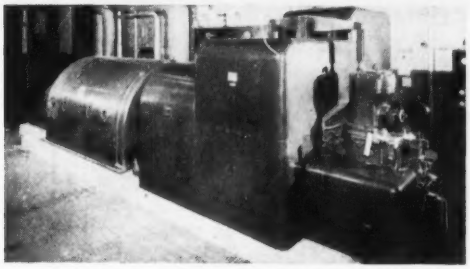

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KVA	PH.	PRI.	SEC.	MAKE	
16,667	3	88,000	11,500	G.E.	(2)
1,667	1	12,470	2400	Al. Ch.	(3)
1,000	3	13,500	260	Kuhl	(2)
1,000	3	4,160	2400	G.E.	(1)
750	3	33,000	120/208	West.	(1)
333	1	12,000	240/480	West.	(3)
300	3	4,000	120/208	G.E.	(2)
300	3	4,000	120/208	West.	(2)
300	3	480/240	240	West.	(1)
250	1	11,550	480	Al. Ch.	(3)
200	1	13,200	2400/4160Y	G.E.	(3)
100	1	13,800	115/230	G.E.	(2)
75	3	4,160	240	UPTGF	(1)
50	1	2400/4160	240/480	G.E.	(3)
50	1	600	120/240	West.	(3)

A. C. MOTORS

HP	RPM	VOLTS	MAKE	TYPE
1500	180	2300	West.	Synch.
1200	1200	2300	Al. Ch.	Sq. Cage
1200	120	2300	West.	Synch.
800	900	2300	G.E.	Slip Ring
800	257	2300	G.E.	Slip Ring
600	1200	2300	Al. Ch.	Synch.
550	257	440	West.	Slip Ring
500	1200	2300/4160	G.E.	Synch.
500	514	2300	G.E.	Slip Ring
500	900	440	G.E.	Synch.
500	1200	4160	West.	Sq. Cage
500	720	550	West.	Synch.
450	720	2300	West.	Slip Ring
350	600	440	Elect. Mach.	Synch.
300	1800	2300/4160	Elect. Mach.	Synch.
300	1200	440	G.E.	Slip Ring
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750	El. Machy.	Synch.	480	514
700	G.E.	Slipring	2300	514
600	G.E.	Synch.	480	900
600	Elliott (2)	Sq. Cage	2300	900
500	Al. Ch. 3 brg.	Slipring	440	514
500	Allis Ch.	Slipring	2300/440	600
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2300	3600
400	G.E.	Slipring	2200/440	600
400	El. Machy.	Synch.	2300/4000	400
450	Allis Ch.	Sq. Cage	2300/440	720
350	El. Machy.	Synch.	2300	900
350	G.E.	Sq. Cage	2200	1800
300	G.E.	Slipring	220/440	514
250	G.E.	Sq. Cage	440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	Whse.	Sq. Cage	2300/440	600
250	Whse. (4)	Slipring	2300/440	600
200	Gen. Elec.	Synch.	550/440	400
200	G.E. b.b.	Sq. Cage	220/440	720
200	G.E.	Slipring	220/440	450
200	G.E.	Slipring	440	600
200	G.E.	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	2200/440	720
200	A.C. TEFC	Sq. Cage	2300/440	1200
150	Whse. b.b.	Sq. Cage	440	1800
150	Cr. Wheeler	Sq. Cage	440	450
150	G.E. TEFC (4)	Sq. Cage	220/440	900
150	Whse. XP	Sq. Cage	440	3600
150	G.E. (4)	Slipring	2200/440	600
150	Whse.	Slipring	220/440	1200
125	Whse. b.b.	Sq. Cage	220/440	900
125	A.C. TEFC	Sq. Cage	220/440	1800
125	El. Machy. (2)	Synch.	220/440	400
125	G.E. TEFC	Sq. Cage	2200	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
125	G.E. (2)	Slipring	220/440	514
125	G.E.	Sq. Cage	2300/440	1200
100	Allis Ch.	Slipring	2300/440	600
100	Al. Ch. TEFC	Sq. Cage	2300	1800
100	G.E. TEFC-XP	Sq. Cage	220/440	1200
100	G.E. b.b.	Sq. Cage	220/440	3600
100	G.E. (2)	Slipring	220/440	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Gen. Elec.	CY-221	250/350	1200
200	Gen. Elec.	RC	250	1450
100	Delco b.b.	late	130/240	1200
75	Allis Ch. b.b.	EB-146L	125	1800
60	G.E. b.b.	CD-	600	1750
50	G.E. (2)	CD-1129	250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (2)	RC-38	230	1150
200	Whse. b.b.	SK	250	287/575
150	Rel. TEFC b.b.	2550-F	230	850
150	Whse.	SK-210	230	320/1000
125/150	F.M. b.b.	DXZD	230	325/1200
125	G.E.	CD-173	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
100	El. Dyn. b.b. (2)	30-S	230	450/1200
100	G.E. crane	CO-1831	230	575
75/100	Whse.	SK-191	230	300/900
60	G.E. TEFC b.b.	CD-135	230	1150
30/40	L.A. b.b. (2)	ONW	230	500/1500

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
300	G.E.	440 AC	250/350 DC
200	Allis Ch. (3)	440 AC	250 DC
200	Whse. synch.	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
135	Whse.	220/440 AC	250 DC
100	Delco b.b.	220/440 AC	130/240 DC
80	Star b.b. Synch.	220/440 AC	250 DC
75	Whse. Synch.	220/440 AC	250 DC
60	Ideal	220/440 AC	125 DC
50	Whse. synch.	220/440 AC	250 DC
30	G.E. (3)	220/440 AC	125 DC
30	Whse.	220/440 AC	250 DC

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1000 KW, Worth.-Moore, Cond. Extr. Turbine, 3/60, 245/490V, 3600 RPM 130-230 PSIG, 10# Extr.

1000 KW, G.M. 16-278A, Diesel Units(2) 3 ph. 60 cycle, 2300 V, 720 RPM

300 KW, G.M. 8-268A, Diesel Units (2) 3 ph. 60 cycle, 480 V, 1200 RPM

500 KW, .8 P.F. West. 3/60, 240/480 V 300 RPM, Gen. direct conn. to Ames Vertical Uniflow Engine.

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BATTLESHIP U. S. S. KENTUCKY

Installed but never used
Built of finest materials

WESTINGHOUSE 1250 K.W. TURBO-GENERATORS

(4)—Westinghouse—440/3/60—850°—540 lbs. working pressure. Complete with condensers, circulating pumps, etc.

BOILERS

7 B&W EXPRESS TYPE

Design pressure 634# — operating pressure 565# — temp. 850°F. Oil fired — separately fired superheaters. *Capacity: 210,000 lb.* steam/hr. ideal for testing where large quantities of steam are required, giving excellent control from separately fired superheaters. Can be converted for #2 oil and natural gas. Fully automatic.

LARGE DEAERATING FEED HEATERS

Monel construction—spray type—capacity 480,000 lbs./hr.—vent condeaser—single pass—heating surface 174 sq. ft.—all Monel construction.

GE HIGH AND LOW PRESSURE MAIN PROPELLING TURBINES

Will sell separately for testing, wind tunnel or similar work. (2) high pressure—24,400 HP—12 impuse stages—4909 RPM—working pressure 540 lbs.—825°F. (2) low pressure—28,600 HP — 3913 RPM — working pressure 49 lbs. steam—424°F—2-6 stages of impulse.

FEED PUMPS

Ingersoll-Rand—5"—three stage—500 GPM at 750 lb. discharge. BHP 330—5000 RPM—Worthington turbine—573 lbs.—non-condensing—back pressure 20 lbs.

FORCED DRAFT BLOWERS

29,000 CFM—max. static 35"—normal 21"

LUBE OIL COOLERS

MANY OTHER ITEMS FOR SALE.
SEND US A LIST OF YOUR REQUIREMENTS

THE BOSTON METALS CO.

313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 — LEXINGTON 9-1900

Circle 515 on Reader Service Card

"Opportunity" Advertising
Think
"SEARCHLIGHT"
First

BARGAINS!

1050 HP FAIRBANKS-MORSE DIESEL MODEL 32, 7 CYL., 257 RPM, 726 KW, FM 3/60/2400 WITH EXCITER, SWITCHBOARD, ETC. VERY LOW PRICE.

3000 CFM WORTHINGTON AIR COMPRESSOR 2 STAGE, HORIZONTAL, 164 RPM, 5 STAGE CONTROL. 650 HP 3/60/440 SYNCHRONOUS MOTOR. COMPLETE ACCESSORIES.

WHISLER EQUIPMENT CO.
1908 Railway Exchange Building
St. Louis 1, Mo.

Circle 517 on Reader Service Card

RE-NU-BILT ELECTRICAL EQUIPMENT

53 YEARS SERVICE

MOTOR GENERATOR SETS

Qu.	KW	MAKE	RPM	AC VOLTS	DC VOLTS
2	4800	G.E.	450	2300/4600	250/300
1	2500	WHSE.	720	2300/4160	600
1	2100/2400	G.E.	450	2300/4600	250/300
2	1750/2100	G.E.	514	2300/4600	250/300
1	2000	G.E.	514	2300/4600	600/666
1	1500	G.E.	720	13200/6600	600
1	1500	Cr. Wh.	720	2300/4160	30/100
1	1250	WHSE.	720	2300/4000	600
1	1000	G.E.	900	2300/4000	600
1	1000	G.E.	900	6600/4000	260
1	1000	G.E.	720	2300/4000	275
1	500	G.E. Unused	1200	2300	300
1	500	G.E.	900	2300/4600	250
1	500	G.E.	900	440	250/125
1	350	G.E.	900	440/4160	125
2	300	G.E.	1200	2300	275
1	300	WHSE.	1200	2300/4160	600
1	200	G.E.	1200	2300/4160	250
1	200	G.E.	1200	440	250

FREQUENCY CHANGER SETS

Qu.	KW	MAKE	FREQ.	VOLTAGES
1	12500	WHSE.	60 To 25	13200-13200
1	5000	G.E.	60/50/60	1100-6600
1	2500	G.E.	60/24/60	2400-2400

3 PHASE 60 CYCLE MOTORS

SLIP RING

	HP	MAKE	TYPE	VOLTS	SPEED
1	1750	G.E.	M-579BS	4800/2400	1800
1	800	G.E.	MT-428	2200	450
1	800	WHSE.	CW	550/2200	1776
1	600	WHSE.	CW-32D	440	1778
1	600	WHSE.	CW	440	850
1	550	WHSE.	CW	440	252
1	500	WHSE.	CW	2300	881
1	500	WHSE.	CW	550/2300	350
1	300	AL. CH.	ANY	2200	720
1	300	GEN. EL.	MTP-561	2200	1760

SQUIREL CAGE

3	1500	G.E.	K D.P.	2200	3580
1	1000	AL. CH.	ANW	2300	1180
1	550/275	WHSE.	CS-1115	2300	863/445
2	500	WHSE.	CSP-583H D.P.	440	3600
4	500	AL. CH.	ARW-D.P.	2300	3600

PUMPS — MOTOR DRIVEN

1—15000 G.P.M. Al. Ch., Type LS—Centrifugal, 20" Suc., 18" Disch., 117 ft. discharge head, with suction 5 ft., Bronze fitted — coupled 500 HP, ANYW-D.P., Wound Rotor Motor, 2300-3-60-880 RPM—Complete Controls.

1—15000 G.P.M. Al. Ch., Type SF-Centrifugal, 18" Suction, 16" Disch., 285 ft. discharge head, with suction head 70 ft., total disch. head 216 ft.,-coupled 1000 HP ANY, D.P., Sq. Cage, 2300-3-60-1180 RPM—Complete Magnetic Reatcor Control

Above 2 Pumps—still installed—practically New—in Water Works Stations

6—600 G.P.M. Gould, Figure 3360, 8 Stage, 2310 Ft. Head, 1000#, 3550 RPM, Each coupled to 500 HP 3-60-3550 RPM D.P. Sq. Cage Motor

2—WHSE, Type CSP-583H, 440 volt

4—Allis Type 2300 volt
Magnetic Encl. Reduced Voltage Starters

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

Phone: OL 3-3334—N.Y.C. RE 2-7150

Circle 518 on Reader Service Card

MISS POWER EQUIPMENT SAYS,
"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed NEW and REBUILT MOTORS"

SQUIRREL CAGE MOTORS NEW AND GUARANTEED

HP	Make	REBUILT	Type	Speed
500	G.E. S.B. Open		IK	1200
400	West. B.B. Drip		CSP-681	1800
400	L.A. B.B. Splash			1800
400	G.E. S.B. Open		IK	1200
400	West S.B. Open		CS	900
350	West. B.B. Drip		CS-22556H	1200
300	L.A. B.B. Splash		FX-1468	1800
300	G.E. S.B. Open		IK	1800
300	Reliance B.B. Drip		AA-6085	1200
300	G.E. S.B. Open		IK	900
300	Cont. B.B. Splash	N-804		900
300	G.E. S.B. Open		IK	720
300	G.E. S.B. Open		KT-561	720
300	G.E. S.B. Open		IK	600
250	G.E. S.B. Open		KT	1800
250	West. B.B. Splash		CS-575	1800
250	G.E. S.B. Open		IK	1200
250	G.E. S.B. Open		IK	900
250	G.E. S.B. Open		IK	720
200	G.E. B.B. Drip		K-6325	1800
200	West. S.S.B. Open		CS-855	1800
200	Cont. TEFCBB		NF-743X	1200
200	West. S.B. Open		CS	1200
200	G.E. S.B. Open		IK-15	1200
200	G.E. S.B. Open		IK-158	1200
200	G.E. S.B. Open 2200 v.		IK	1200
200	G.E. S.B. Open		IK	900
200	A.C. B.B. Open		AR-826	1200
150	West. TEFCBB		CS-8120S	1800
150	G.E. S.B. Drip		K-6324	1800
150	West. S.S.B. Open		CS-771-C	1800
150	Al. Chal. B.B. Open		AR	1800
150	West. S.B. Open 2200V		CS	1800
150	L.A. B.B. Open		115	1200
150	West B.B. Splash		CS-580	1200
150	West. B.B. Drip		CS-772	1200
150	West. TEFCBB		CS-775	1200
150	G.E. B.B. Open		KT	1200
150	G.E. B.B. Open		KT-567	1200
150	Al. Chal. B.B. Open		AR-826	900
150	Cont. TEFCBB		N-748-X	900
150	Al. Chal. TEFCBB		AZ	900
150	F.M. B.B. Open		H-24A	900
150	G.E. S.B. Open		IK	900
150	G.E. S.B. Open		IK	720
125	G.E. TEFCBB		K	3600
125	Burke B.B. Open 440 Volt		N-505	3600
125	Reliance T.E.F.C. B.B.		AA-5084	1800
125	G.E. S.B. Open		IK	1800
125	G.E. B.B. Splash		K-505	1800
125	Al. Chal. B.B. Open		AR	1800
125	G.E. S.B. Open		K1-555	1200
125	Century B.B. Drip			1200
125	G.E. B.B. Open		IK	1200
125	Ideal B.B. Open		A-505	1200
125	F.M. B.B. Open		H	900
125	G.E. S.B. Open		IK	720
100	Al. Chal. T.E.F.C. B.B.		ARZ-823	3600
100	C.W. B.B. Open 2300 Volt		SC-445	3600
100	Reliance T.E.F.C.B.B. New		AA-445U	1800
100	G.E. S.B. Open		KT-343	1800
100	G.E. B.B. Open		K-504	1800
100	Cont. TEFCBB XP		NP-505	1800
100	Al. Chal. B.B. Drip		ARW-823	1800
100	G.E. S.B. Open		KT-347	1200
100	Ideal B.B. Drip New		A-584	1200
100	West. B.B. Open		CS-607	1200
100	West. S.S.B. Open		CS-754-C	900
100	Al. Chal. T.E.F.C. B.B. XP		23E8	900
100	F.M. B.B. Open		H20C	900
100	Al. Chal. B.B. Open		AR-823	900
100	F.M. B.B. Open		H	720
100	F.M. B.B. Open		H	600
75	Reliance T.E.F.C.B.B.			

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NEW & USED Electrical Equipment

FREE CATALOG. This is a partial listing. We are continually changing our stock, and can fill your requirements at any time. Send for our free catalog. In Stock, fractional horsepower up to 500.

Motors, Control Equipment, AC and DC Generators, MG sets and transformers.

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LARGE LINE OF SLIP RING MOTORS & CONTROLS.

POWER EQUIPMENT CO.

8 CAIRN STREET • PHONE BEverly 5-1662 • P. O. BOX 534 • ROCHESTER 2, N. Y.

Circle 519 on Reader Service Card

UNUSED—ASSEMBLED—NEW

IN ORIGINAL MANUFACTURER'S PACKING CRATES

BOILERS (Package type)

B&W—60,000 lbs./hr.—475 psig., 740°TTF, oil fired (shipped intact as one integral unit)
B&W—122,500 lbs./hr.—635 psig., 850°TTF, oil fired (unassembled)
B&W—153,600 lbs./hr.—634 psig., 850°TTF, oil fired (unassembled)

TURBOGENERATORS

4600 KW GE Turbine—Gen Set, Cond 410psi, 725°TTF, 28.5 Hg exh, 3/93.3/2700V PF 1.0—New
1800 KW GE Turbine—Gen Set, Cond 410psi, 725°TTF, 28.5 Hg exh, 3/60/1735 V PF 0.8—New
1500 KW Westinghouse—Gen Set, Non Cond 400psi, 3/60/480V PF 0.8
1000 KW Westinghouse Turbine Gen. Set. Non. Cond. 190psi, 800°TTF, 3/60/480V/3600RPM PF 0.8

STEAM TURBINES

1000 SHP GE Cruising Cross Compound, 525psi, 825°TTF, 81psi exh, 10,119/350 RPM with Falk reduction gears—New
3000 SHP GE HP Main propulsion turbine 410psi, 9040RPM, 725°TTF
3000 SHP GE—LP Main propulsion turbine 40psi, 9040RPM
} 1 Set—New
11,550 SHP GE HP 12 Stage Cross compound turbine 525 psig, 825°TTF 5870RPM
13,450 SHP GE LP 48psig, 4714RPM with Westgh speed decreaser gear assy.
} 1 Set—New
294 HP Worthington-Moore, Non-Cond. Form #82R, 310psig, 650°TTF, 2psi-exh, 3560RPM
250 HP Sturtevant non-condensing Turbine—575psi, New

PUMPS, CENTRIFUGAL (Motor driven)

263 GPM @ 375'TDH, Ingersoll Rand—2GT, w/60HP 3525RPM 3/60/220/440V (Used)
275 GPM @ 635'TDH, Ingersoll Rand—2GT, w/75HP 3525RPM 2/60/2300V (Used)
200 GPM @ 1300'TDH, Ingersoll Rand—½CNTA, w/Base, Motor optional

PUMPS, CENTRIFUGAL (Turbine driven)

460 GPM @ 750psi discharge, Worthington, w/350HP turbine, 575psi, 4900RPM—New

BLOWERS, TURBO-CENTRIFUGAL

20,000 CFM @ 17"WC, Westinghouse, Vaneaxial, w/Turbine, 82.5HP, 375psi, 10psi—exh, 4625RPM—New
24,000 CFM @ 28"WC, Sturtevant Co, Rexvane, w/Turbine, 191HP, 490 psi, 10psi—exh, 3525RPM—New
31,250/24,000 CFM @ 45"/28" W.C. Sturtevant Propeller-Fan w/182HP, 575psi, 15psi exh, 5850/4800RPM

WABASH POWER EQUIPMENT CO.

3300 W. PETERSON AVE., CHICAGO 45, ILLINOIS—TEL. IN 3-0303
3757 WILSHIRE BLVD., LOS ANGELES 5, CALIF.

Staffed by Professional Engineers

Circle 520 on Reader Service Card

MOTOR GENERATOR SETS

Q	KW	MAKE	D.C.	A.C.	RPM
2	750	G.E.	250	3/60	720
1	500	Elliott	125	3/60	720
2	300	G.E.	250	3/60	1200
1	150	West.	250	3/60	1200
1	100	Star	250	3/60	1200

STEAM- TURBO- GENERATORS 3/60

Q	KW	MAKE	TYPE	I.S.P.	YEAR
1	10000	West.	Cond.	275	1932
1	7500	G.E.	Cond.	275	1948
2	7500	West.	Cond.	400	1945
1	5000	West.	Cond.	400	1938
1	5000	West.	N. Cond.	850	1941
1	3500	West.	Cond.	400	1936
1	3000	G.E.	Cond.	400	1940
1	2500	G.E.	N. Cond.	180	—
1	2000	G.E.	N. Cond.	180	—
1	1000	Elliott	N. Cond.	325	1930
2	1000	Elliott	Cond.	150	1949

PACKAGE BOILERS

Q	HP	MAKE	W.P.	FIRING	YEAR
1	400	Cl. Bk	150	#6	1948
1	400	T'Ville	150	#6	1948
1	200	Erie	160	#6	1951
1	150	Cyclotherm	150	#6	1947
1	150	Cl. Bk	15	#6	1956
1	90	Cyclotherm	125	#2	1945
1	80	Cl. Bk	125	#6	1948
1	70	Ames	15	#2	1951
1	60	Cyclotherm	125	#2	1945

DIESEL GENERATOR SETS

Q	KW	MAKE	VOLTS	RPM
2	2000	Baldwin	230V.D.C.	257
2	1125	F.M.	400V.D.C.	720
2	1000	G.M.	3/60/2400	720
1	620	Alco	240V.D.C.	700
1	400	Worth.	3/60/480	600
1	300	G.M.	3/60/220-440	1200
1	300	G.M.	230V.D.C.	1200

AIR COMPRESSORS

CFM	PSI	MAKE	TYPE	H.P.	VOLTAGE	RPM	YEAR
7550 (2)	24/30	I.R.	XHE	600	3/60/4160	300	1948
6000	125	Sullivan	H	1250	3/60/2300	200	1943
2200	125	I.R.	PRE-2	350	3/60/2300	300	1943
1853	125	Worth.	DC-2	300	3/60/2300	277	1946
1530 (2)	125	Worth.	OXP	250	Steam	200	1943
1308	125	C.P.	OCE	225	3/60/440	257	1937
1300	125	I.R.	XRE	225	3/60/440	257	1940
570	125	Gardner	WBK	150	3/60/440	870	1951
515 (4)	125	I.R.	40	100	3/60/440	870	1940/50
500	125	I.R.	K500		Diesel Portable		1948
494	125	I.R.	XRB	75	3/60	277	—
464	100	I.R.	ES-1	75	3/60	300	1950
387	125	I.R.	40	75	3/60	870	1945
368	100	I.R.	ER-1	60	3/60	277	Late
250	2500	Worth.	3 stg.	175	3/440	257	Late
218	200	I.R.	40	50	3/60	870	Late
211	100	I.R.	E.S.	40	3/60	325	1948
174	125	Worth.	H	30	3/60	300	1940
173	100	I.R.	E.R.	30	3/60	300	1945

"Everything from a Pulley to a Powerhouse"

THE O'BRIEN MACHINERY CO.

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1915 W. CLEARFIELD ST., PHILADELPHIA 32, PA.

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FEATURED ITEMS

BOILERS

44500 #/hr CE 450 PSI @ 750°F NEW unassembled
35000 #/hr CE 285 PSI @ 577°F NEW unassembled
18000 #/hr Keeler CP 160 PSI
620 #/hr Cyclotherm 250 PSI

AIR COMPRESSORS

6700 CFM @ 125 PSI Sullivan 1250 HP
1360 CFM @ 35 PSI Worthington YO 150 HP
800 CFM @ 100 PSI Ing. Rand XLE 14½ & 9x7 125 HP
387 CFM @ 100 PSI Ing Rand Type 40 75 HP
142 CFM @ 100 PSI Ing Rand Type 40 25 HP

TRANSFORMERS

2000 KVA Al. Ch. 33000—2400 3/60—(2)
2000 KVA West. 13800—2400 1/60—(4)
500 KVA Al. Ch. 2400—480 3/60—(2)
500 KVA West. 2300—440 1/60—(3)
500 KVA Wagner 66000—480 1/60—(3)
200 KVA West. 2300—230/460 1/60—(3)
6000 KVA 44000—4160 3/60 Substation

MOTOR GENERATOR SETS

750 KW Cr. Wh. 3/60/2200/720 RPM—250 V DC
750 KW G.E. 3/60/2200/900 RPM—250 V DC

MOTORS — Exp. P.F.

350 HP Al. Ch. 3/60/2300/450 RPM Nitrogen filled
350 HP Al. Ch. 3/60/2300/3600 RPM Class 1 Group D
250 HP Cont. 3/60/2300/720 RPM Class 1 Group D
250 HP Al. Ch. 3/60/2300/3600 RPM Class 1 Group D
250 HP G.E. 3/60/2300/3600 RPM Class 1 Group D
200 HP G.E. 3/60/2300/3600 RPM Class 1 Group D
150 HP Al. Ch. 3/60/2300/3600 RPM Class 1 Group D

NATURAL GAS ENGINE GENERATORS

(Can be seen running)
1250 KVA Rathburn Jones—3/60/2400-4160

TURBO GENERATOR SETS

1250 KVA G.E. 3/60/2300/3600 RPM Cond. 200 PSI (2)
540 KW West. any Voltage—Cond. 200 PSI
1875 KVA Surface Cond. 400 PSI, 700°FTT

HEAT & POWER CO. INC.

60 East 42nd St., New York 17, N.Y.
310 Thompson Bldg., Tulsa 3, Okla.

Circle 522 on Reader Service Card

Buying
Good USED Equipment
is frequently the difference between having needed equipment or doing without it.

DIESEL GENERATOR SETS

(4) NEW 500 KW GM 8-278

Engines — 715 HP — Vee type — 8 cylinder — 8½ x 10½ — air starting — 720 RPM — 2 cycle — heat exchanger cooled. Engines drive 500 KW Allis-Chalmers D.C. generators—120/240 — 2080 amps — 720 RPM — compound wound. Complete with a very generous supply of spare parts. IF YOU NEED D.C. POWER, NOTHING CAN BEAT THIS VALUE. FULLY GUARANTEED.

NOTE:
We can also quote you using the above engine — radiator cooled and with an A.C. generator — either 440/2300 or 4100 — and offer a completely portable unit.

EXCELLENT GENERATORS FOR STANDBY POWER
(1) UNUSED 250 KW UNIT

440/3/60 — 900 RPM Westinghouse generator — driven by a Cooper-Bessemer 8¾ x 11 engine model F.S.6 — Heat exchanger cooled. This is an unused set in prime condition. Will demonstrate. Unit is a slow-speed heavy duty diesel generator.

(2) AS ABOVE, RECONDITIONED

Send us your inquiries

THE BOSTON METALS CO.
313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 LEXINGTON 9-1900

Circle 523 on Reader Service Card

3—Wagner 500 KVA transformers, single phase, 66,000—460 volt.
1—Gardner-Denver air compressor, 445 cfm @ 100# pressure, 6 cylinder, 2-stage, 1952.
2—E. Keeler 200 HP water-tube boilers, 100 psi, Stoker fired, 1945.
1—Kennedy 7' x 9' ball mill pulv.
1—Babcock & Wilcox #32E coal pulverizer
1—Raymond 50", 5 roler hi-side mill.
1—24" x 538' long trough belt conveyor.

PERRY EQUIP. CORP.
1422 N. Sixth St.
Philadelphia 22, Pa.
PO 3-3505

Circle 524 on Reader Service Card

FOR SALE

General Motors 16-567 Diesel Engine, Westinghouse Generator, with 2400/4160 volt or 4600. It can be used at 2400 or at straight 4600. Generator with all accessories including switch gear and about $4,000 in spare parts. Offered for $40,000 loaded on cars. Also have a number of other slow speed units. We would appreciate your inquiries.

ARTHUR G. PORTER
6345 Washburn Ave. So.
Minneapolis 23, Minn.
UNion 9-2434 — UNion 9-4414

Circle 525 on Reader Service Card

BOILERS

Two (2) SUPERIOR STEAM GENERATORS (PACKAGE) 200 H.P., 15 lb., No. 6 Oil —New Condition.

One (1) ERIE CITY ECONOMIC (PORTABLE) 250 H.P. 125 lb., No. 6 Oil.

Two (2) PENNSYLVANIA BOILER FEED PUMPS. Motor 30 H.P. 220 Volt, 60 Cycle, 3 Phase and Controller 150 G.P.M., 465 ft. Head. Turbine 25 H.P., 150 G.P.M., 465 ft. Head.

One (1) BAILEY FEED WATER PANEL.

JOSEPH KRAUSS, INC.
P.O. Box 95, Ramsey, N. J.

Circle 526 on Reader Service Card

SEARCHLIGHT EQUIPMENT
Locating Service

No Charge or Obligation

This service is aimed at helping you, the reader of "SEARCHLIGHT", to locate Surplus new and used Power Equipment not **currently** advertised. (This service is for USER-BUYERS only.) How to use: Check the dealer ads to see if what you want is not **currently** advertised. If not, send us the specifications of the equipment wanted on the coupon below, or on your own company letterhead to:

Searchlight Section Locating Service
c/o POWER
330 W. 42nd St., N. Y. 36, N .Y.

Your requirements will be brought promptly to the attention of equipment dealers advertising in this section. You will receive replies directly from them.

Searchlight Section Locating Service
c/o POWER
330 W. 42nd St., N. Y. 36, N. Y.

Please help us locate the following equipment components.

.....
.....
.....

NAME .....
TITLE .....
COMPANY .....
STREET .....
CITY 1/61

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/6600-4160/2400
3	50	Amer.	WF Dry	1	460/230-230/115
6	37½	G.E.	Dry	1	460/230-230/115
3	333	G.E.	HS		2400/4160-240/480
3	200	Al.-Ch.	CBS	1	2400/4160-240/480
3	200	Amer.	CC	1	4160/7200-240/480
3	75	G.E.	KF	1	2400/4160-120/240
1	50	Amer.	Abestol	3	4160-120/208Y
3	50	Niagara	Dry	1	2400/4160Y-120/240
3	50	Harrison	Dry	1	2400/4160Y-220/440
2	3000	G.E.	OA-T	3	28,400-4160/2400
6	25	G.E.	Dry	1	2200-440

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	400	West.	1200	250	Syn. 4150V.
1	75	G.E.	1200	125	2360/4160 Syn.
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y SR
1	300	Al.-Ch	1200	125/250	Syn. 440V.
1	1000	West.	720	600	2300/4160Y Syn.

ENGINE GENERATOR SETS

1—Hercules Gas HXE 62.5 KVA Weighe 3/60/480 —1200

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
1	300	G.E.	1170	1-E-15A	4150
1	60	G.E.	1800	MT	220
2	150	G.E.	585	1-16	4150
1	75	G.E.	600	IM	440
1	100	West.	1800	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-RW	2300
1	250	West.	600	CW	440
1	250	West.	1800	CW	2300
1	450	West.	1800	CW-4-30-9	220
1	500	G.E.	450	MT	2200
1	500	G.E.	1200	M369Z	2300/4160Y
1	50	G.E.	570	MT552	220/440

D. C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	350	G.E.	1200	Pedestal
1	30	G.E.	1750	173 FR
1	30	West.	600/1400	SK-4G1545

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—300 HP, 1200, Allis. Chalmers, 2300/4160Y
1—275 HP, 1130 RPM G.E. Type KT 559BS 2200V
3—200 HP, 1790 RPM, G.E. Elec. KP, TEFC, 2300V
2—150 HP, 1800 G.E. TEFC Exp. 220/440
1—100 HP, 1775 RPM G.E. KTP-543 3 ph 60-440V.
1— 75 HP, 3600 RPM Cont. NP 505—440V Exp. P
1— 50 HP, 3600 Cont. Ex. Pr. 220/440
2—100 HP, 3600 RPM Cont. NP 585-S 440V X.P.
1—100 HP, 1200 RPM West-CSP 220/440
1—300 HP, 450 RPM GE TS 7656-2200

MOTORS—SYNCHRONOUS—3 ph. 60 cy.

100 HP 900 RPM G.E. Form BL 2200V.
125 HP 600 RPM G.E. Type TS 2300 V.
125 HP 900 RPM Elect. Mach. 4800 V.
150 HP 3600 RPM G.E. type TS Fr. 956T 2200 V.
150 HP 1800 RPM G.E. Type TS 230 V.
300 HP 720 RPM Elec. Machinery t.e.f.c. 2300 V.
325 HP 900 RPM West—2300 V.
400 HP 450 RPM Westinghouse Type HR 440 V.
75 HP 1200 RPM Crocker-Wheeler Type ALT 220/440 V. B.B.

FOR POWER
J. L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK (CONGRESS) 1-7211
PHONE N.J. UNION 4-1010

Circle 527 on Reader Service Card

COMPRESSORS

No better values at any price

100 CFM	150 PSI 6x7 Ing. ES-1
138 CFM	100 PSI 7x7. Ing. ES. CP & Joy
288 CFM	100 PSI 9x9 Ing. Worth. CP
321 CFM	125 PSI 10x11 Ch. Pn. T
351 CFM	350 PSI 11-5x11 CP TCB-2
364 CFM	100 PSI 10x9 Joy WG9
465 CFM	100 PSI 12x11-1R-ES-1" Chic. P.T.
502 CFM	125 PSI 12x13 Worth HB
593 CFM	125 PSI 13½-8½x8 Worth DC2
686 CFM	100 PSI 14x13 Ing. ES
800 CFM	100 PSI 14¼-9x7 Ing XLE 125 HP Syn. 3-60-2300
877 CFM	125 PSI 17-10½x14 IR, XRB-CV
1665 CFM	100 PSI Fuller—C-300-300H 300 HP Syn 3-60-440 .8 PF
2520 CFM	125 PSI 17-10¾x8 Clark, CMA4L 350 HP 3-60-2300 (1954)

AMERICAN AIR COMPRESSOR CORP.
48th & P, North Bergen, N.J. UN 5-1397

Circle 528 on Reader Service Card

500 HP, 1200 RPM SYNCHRONOUS MOTORS

Unused 500 HP General Electric, type TS, synchronous motors, 3 phase, 60 cycle, 2300 volts, 1200 RPM. Rated 375 KVA at unity power factor, 40° C. rise at the stator winding, with direct connected enclosed outboard exciter 125 volts DC, of standard horizontal drip proof, ball bearing construction, model #31G893, frame size 974S. Sample serial #6917036. Terminal box now located on right hand side when facing shaft end.

L. J. LAND, INC.

P. O. BOX 689 WEEHAWKEN, N. J. UNION 4-1010
P. O. BOX 756 READING, PA. FRANKLIN 5-8474

Circle 529 on Reader Service Card

38 Years Dependable Service

SLIP RING MOTORS 3 Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	4000/2300	G.E.	1200
400	2300/440	G.E.	600
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	440	Whse.	3600
250	4000/2300	Al. Ch.	600
200	2300	G.E.	600
200	2200/440	G.E.	720
150	440/220	G.E.	1800
150	2200/440	Whse.	720
125	2300	G.E.	600

AC GENERATORS or SYN MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300	G.E.	TS	1800
400	2200/440	G.E.	ATI	720
300	2200/440	G.E.	TS	1200
300	440	G.E.	TS	720
150	440/220	Whse.	G	1200
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2200/4000	Elliott	SC	1800
400	2300	G.E.	FT	3600
400	2300/4000	G.E.	K	1200
350	2300/4000	G.E.	SEDP	3600
350	2300/4000	G.E.	K	600
300(2)	2300	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
300	2300/400	G.E.	KT	600
250	2300/4000	G.E.	K	720
250	2300/440	G.E.	K	1200
200	2200	G.E.	KT	1800
200	2200	Cont.	TEFC	3600
150	440	Whse.	X-pf.	3600
150	440/220	Cont'l.	X-pf.	1800
150	440/220	G.E.	TEFC	720
150	2200/440	G.E.	TEFC	3600
125	2200/440	G.E.	FT	1200
100	440	Whse.	TEFC	3600
100	440	Cont.	X-pf.	1800
100	2200	G.E.	FT	900
100	440	Al. Ch.	Spl-Pf.	900

CIRCUIT BREAKERS, 3 Pole

2—1600 Amp., G.E., AL-50, 600 V., Air
1—1600 Amp., G.E., AL-50, 600 V., outdoor
1—1200 Amp., Whse., F-124, 7.5 KV, manual
1—600 Amp., G.E., 15 KV, Sol. oper.
1— 600 Amp., Whse., 7.5 KV, outdoor, New.

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
150	230	El. Dyn.	B/brg.	800
90	230	G.E.	CD	1750
50	230	G.E.(4)	CD	1150

MOTOR GENERATOR SETS

KW	Make	Input., AC	Motor Type	Output V., DC
300	Whse.	4150/400	Syn.	250/125
150	G.E.	440/220	Syn.	250
125	G.E.	440/220	Sq. Ca.	125
100	G.E.	2200/440	Syn.	250
65	G.E. B	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

3—500 kva, Whse., 4160-240 V., 3 ph., Inerteen
3—500 kva, G.E., 13,800—240/480 V.
3—200 kva, Mol., 13,800—2300 V.
3—333 kva, G.E., 13,800—2400 V.
3—333 kva, G.E., 2400—240/120 V.
3—333 kva, Whse., 2400/4160Y—240/480 V.
1—300 kva, Whse., 4160—480 V., Dry, New
3—250 kva, Whse., 2400/4160Y—240/480 V.
3—200 kva, G.E., 2400—460V. Pyr.
3—200 kva, G.E., 13,800—480 V.
3—200 kva, G.E., 4156—480/240 V.
3—167 kva, Whse., 4156—480 V.
3—150 kva, Al. Ch., 2400—220 V.
3—150 kva, G.E., 13,200—2300 V.
1—150 kva, Whse., 4160—120/208Y V., 3 ph. Dry New
3—100 kva, Whse., 2400—240/480 V., Dry
3—100 kva, G.E. 2400—120/240 V., Pyr.

only partial listing

STEPHEN HALL & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

Circle 530 on Reader Service Card

TRANSFORMERS

BOUGHT · SOLD · RENTED
REWOUND · RE-DESIGNED
MANUFACTURED
Ask for our Stock List

For Sale

3—2500 KVA G-E 69000—2300Y
3—2500 KVA G-E 69000—2400/4160Y
3—2500 KVA G-E 69000—7200/12470Y
4—2500 KVA W-H 34500—2400/4800/11000
3—1500 KVA G-E 69000—2300Y
3—1500 KVA G-E 69000—2400/4160Y
3—1500 KVA G-E 69000—7200/12470Y

THE ELECTRIC SERVICE CO., 5322 Hetzel St., Cincinnati 27, Ohio
"America's Exclusive Independent Transformer Service Shop"

Circle 531 on Reader Service Card

MODERN POWER BOILERS

1—Babcock & Wilcox	—122,000#s/hr	—250 psi
3—Combustion-Engineering	—110,000	—200 psi
1—Riley	—100,000	—456 psi
1—Babcock & Wilcox	—100,000	—450 psi
1—Babcock & Wilcox	— 90,000	—263 psi
1—Combustion-Engineering	— 75,000	—250 psi
1—Riley	— 70,000	—250 psi
2—Babcock & Wilcox	— 70,000	—450 psi
1—Riley	— 60,000	—290 psi
2—Combustion-Engineering	— 50,000	—250 psi
1—Babcock & Wilcox	— 45,000	—450 psi
1—Combustion-Engineering	— 40,000	—220 psi
1—Foster-Wheeler	— 40,000	—200 psi
1—Babcock & Wilcox	— 35,000	—300 psi
2—Riley	— 35,000	—250 psi
1—Babcock & Wilcox	— 27,500	—450 psi
2—Riley	— 19,000	—200 psi

MIDWEST BOILER & TURBINE CO.
WARNER NEW HAMPSHIRE PHONE 244

Circle 532 on Reader Service Card

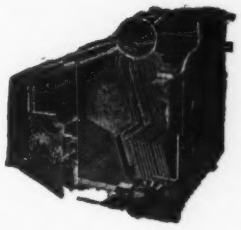
FOR SALE

1500 KW, 80% Power Factor, 3 phase, 60 cycle, 2300 volts, 3600 RPM, General Electric 5-stage noncondensing steam turbine generator unit, 375 PSIG, 700° FTT, 125# exhaust back pressure, complete with direct connected shaft exciter and switchgear. Excellent condition—available immediate delivery.

EUCLID ENGINEERING CORPORATION
909 National City East Sixth Building
Cleveland 14, Ohio

Circle 533 on Reader Service Card

BOILERS NEW UNASSEMBLED



# Steam/hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

Pelnik-Loconti Industrial Supply, Inc.
315 Oriskany St., Yorkville, N.Y.
Utica, N. Y. Ph. RE 6-4621, RE 2-4513

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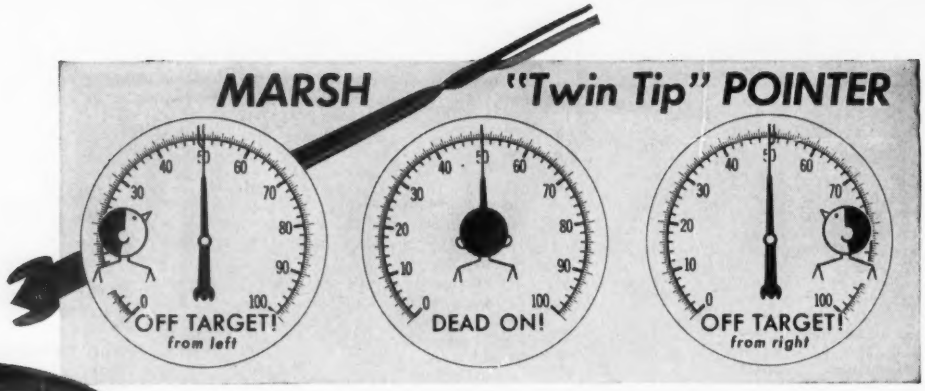


Now *reading accuracy* in keeping with *instrument accuracy*

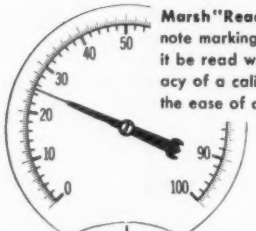
The development of the "Master-test" series brought industry pressure gauges of almost incredible precision ... gauges individually dead-weight tested ... gauges guaranteed accurate within ¼ of 1% of full scale reading.

But this extreme accuracy would have been meaningless unless the gauge could be *read accurately*—unless some means were provided for sighting the scale "dead on."

That was the reason for developing the "Twin-tip" pointer illustrated here. With the "Twin-tip" there is no excuse for wrong reading. If two tips are showing you're "off." If only one tip is showing you're dead on the target. It's as simple as that.

The Twin-tip has been declared a real innovation by all who have seen it. In addition to the "Twin-tip", "Master-test" gauges are also available with a Mirror Scale or with a "Non-parallax" scale which also provide reading accuracy in keeping with gauge accuracy. To make reading still easier all "Master-test" gauges have the "Read-easy" scale, illustrated opposite—another Marsh development.

"Master-test" gauges are made in sizes 4½", 6", 8". All standard ranges from 0-15 to 0-30,000 psi. Vacuum and compound types. Full range of case patterns.



Marsh "Read-Easy" Dial note markings that permit it be read with the accuracy of a caliper, yet with the ease of a clock.

Conventional Dial markings are crowded in—hard to read.

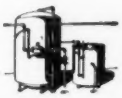
Ask for this 20 page bulletin

MARSH

"THE STANDARD OF ACCURACY"

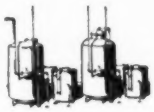
MARSH INSTRUMENT COMPANY, Dept. F, Skokie, Ill.
Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta
Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas

For more facts circle 301 on Reader Service card, p 99

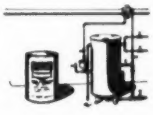


ZEOLITE WATER SOFTENER — manual and automatic. Up to 44% more soft water output from a softener of given size.

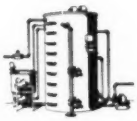
ULTRA-DEIONIZERS — produce highest quality mineral-free water. Replace distillation methods at fraction of distillation cost.



DEALKALIZATION & ION EXCHANGE SYSTEMS—Dealkalizers to control alkalinity. Ion Exchangers to produce water of any desired quality.

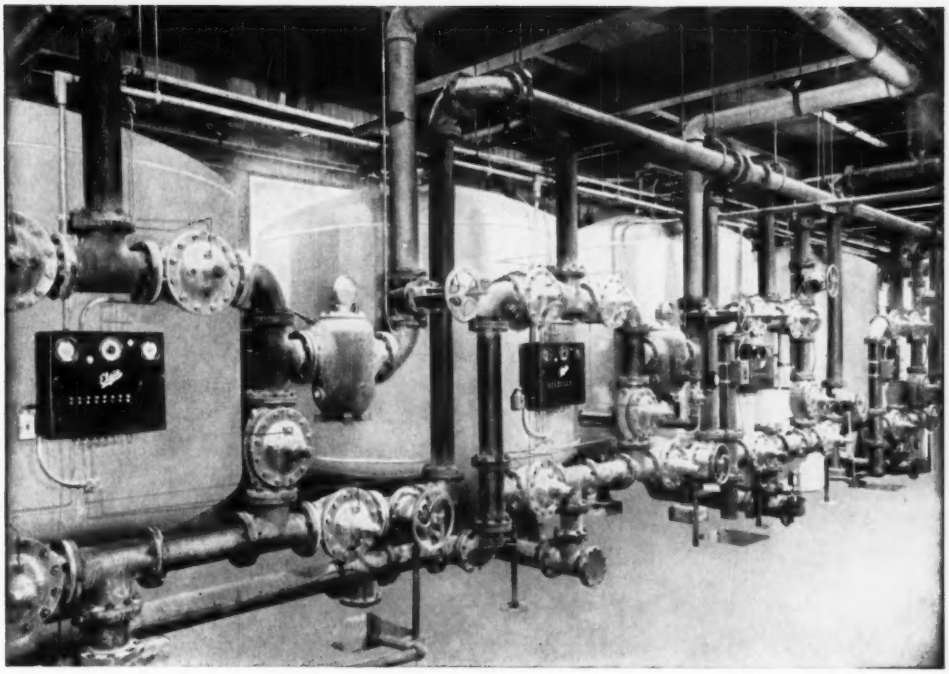


CHEMICAL TREATMENT SYSTEMS—prevent scale, corrosion and depositions with Elgin specially formulated chemicals.



CLARIFIER—for removing excess alkalinity and solids for clarification of turbid waters.

DEGASITORS—for removal of entrained gases from water by aeration.



Typical Elgin Automatic Deionizer

WHO IS QUALIFIED

To handle your water conditioning job?

Today's remarkable advances in water conditioning should suggest methods and equipment that can perform a profitable service for you . . . and this brings up the all-important question:

Who is best qualified to get right down to the practical job of putting these advanced methods to work for you under your specific conditions?

Certainly the best answers will be found in an organization like Elgin that knows and offers *every* modern and authoritative approach to *any* water conditioning problem.

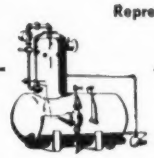
The scope of Elgin equipment and services is briefly touched upon here. To cover the full line would require many pages, but whatever your problem, Elgin with 50 years of intensive specialization is well qualified to solve it. No other organization is better equipped to determine your needs and meet them in the best and most economical way.

Your nearest Elgin Representative would like to put our fifty years of experience to work for you. Or, if you prefer, tell us your conditions and we will send covering bulletins.

ELGIN SOFTENER CORPORATION

130 No. Grove Avenue, Elgin, Illinois

Representatives in Principal Cities *In Canada: G. F. Sterne & Sons Ltd., Brantford*



DEAERATING HEATERS—supply make-up water pre-heated by exhaust steam in which CO_2 and oxygen are eliminated.

WATER FILTERS—Diatomite, sand, anthrafilt, activated carbon and oil removal filters in all types and sizes.

ELGIN
WATER CONDITIONING
SINCE 1908

For more facts circle 202 on Reader Service card, p 99

Turbine rotor on dynamic balancing machine—special photographic impression

HOW TO BALANCE "n" TURBINE VARIABLES

This rotor was designed in light of the "n" variables that affect turbine design. No one really knows the number—each installation is different. But they begin with steam pressure and temperature, exhaust steam pressure(s), horsepower and speed requirements, controls, efficiency requirements, and, of course, the nature of the individual application.

Balanced properly, these variables will produce extreme reliability—what we at Worthington believe to be the single most important factor in turbine design.

Balancing these factors in design is, of course, the work of power engineers and turbine specialists. But, it is desirable to have *every* person who is engaged in selection, operation and maintenance familiar with the many factors in mechanical drive turbine design. To help those of your people concerned with turbine application we have just prepared "Let's Talk Turbines." It's a primer on API specifications and other subjects such as turbine types, construction, governing systems and lubrication methods. Write Worthington Corporation, Section 48-12, Wellsville, N. Y.

WORTHINGTON

PRODUCTS THAT WORK FOR YOUR PROFIT

For more facts circle 203 on Reader Service card, p 99

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